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The Physiotherapy Review

Volume 15 Number 5

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XUM

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An Objective Method of Grading Posture

Its Development, Routine Procedure and Applications

Charlotte G. MacEwan, Elizabeth Powell, and Eugene C. Howe

The objective method of grading the posture of college women, described in the following pages, was developed at Wellesley College during the years 1928-30, and has been in use for the past five years. During this time, it has served both as an incentive to students in their efforts toward better posture, and as a guide to instructors in helping them to accomplish it. In addition, it has been used as a partial basis for classification according to the type of activity most profitable for the student, and as a practical tool for research. Several studies, made in an attempt to determine the influence of different types of activity, have led to unexpected results.

During the last year, with seven thousand graded photographs of Wellesley College students available for analysis, still more interesting results have been found: trends in posture status of the entering freshman classes to date; posture changes in relation to participation in various activities; and the individual or group improvement to be expected, according to initial grade, during the freshman and sophomore years. With the invention of the Pameter, a sliding scale which measures comparative improvement according to initial grade, it has become possible to grade students on *posture achievement*, and to gauge the success or effectiveness of the individual instructor's posture training methods. The adoption of the method in recent years by several leading universities has widened the scope of possible analytical study of problems in this field.

The grading scale is applicable at the present time only to young adult women. An analysis of the posture of pre-school and elementary school children has been made, using the technique of this method, but as yet no grading scales have been worked out for these groups. It is hoped that further studies will lead to the development of scales for grading individuals of both sexes at various age levels.

Development of the Method

The first problem in devising a method of grading posture objectively was that of developing a technique which would define on a profile photograph the curves of the spine and the carriage of the chest. Examination of photographs available at the time the study was undertaken showed that many individuals carry the upper back and the arms in such a way that the lumbar curve is partially or entirely concealed. In other individuals the apparent curve of the upper back is in reality due to projecting or heavily muscled scapulae. In no event, could the carriage of the chest be determined accurately. Measurements in such cases would be worthless.

The problem was solved by the use of small aluminum pointers of uniform length, with a right angle bend at one end (Fig. 1). These were attached with small pieces of adhesive tape to the skin over alternate spinous processes from the seventh cervical vertebra to the tuberosity of the sacrum, and to the sternum at the juncture of the xiphoid. The negligible weight of the pointers (each equal to that of two common pins) allowed unrestricted movement and hence would not cause any undue tendency on the part of the individual to assume an unaccustomed pose. The contour of the spine and the position of the chest could be found, then, on the photograph, by the simple expedient of measuring inward the total length of the pointer from its visible end (Fig. 2). A small square of adhesive tape was placed on the center of the external malleolus, to be used as a reference point in connection with measures of weight distribution.

Profile photographs of eight hundred and thirty-eight students, prepared as described above, were taken with a No. 3 Kodak. Identical sets of prints were made and sent, accompanied by a questionnaire, to eight specialists in the field of posture study in various parts of the country, with the request that they grade the photographs from "A" through "E" according to their own standards. As an aid to these judges in evaluating the posture, the proximal ends of the pointers had been located on the negatives, and lines drawn indicating the thoracic and lumbar curves and the height of the chest, and a vertical erected from the fifth metatarsal.

Since three of the judges had worked together for some time in one department, their grades for each student were averaged and treated as those for one judge. By substituting numerical values, 1 to 5, for the letter grades "A" to "E," and totaling the judges' grades for each individual, composite numerical scores were obtained to serve as a criterion for providing which of various measurements would be of greatest value in

Department of Hygiene and Physical Education Wellesley College

Demonstrated in part at the American Physiotherapy Association Exhibit, American Medical Association Convention, Atlantic City, June, 1935.

Fig. 1. Aluminum pointer; weight, ¼ gram. (By courtesy of the Research Quarterly of the American Physical Education Association.)

grading. The intercorrelation coefficients of the judges' grades, ranging from 0.520 to 0.792 with an average of 0.624, are evidence of satisfactory criterion validity. The coefficients for the three judges in one department were somewhat higher, as would be expected, 0.692 to 0.820 with an average of 0.718.

The negatives, meanwhile, were enlarged to an average height of seventeen inches, the proximal ends of the pointers were again located, and numerous measurements made, suggested by the results from the questionnaire sent to the judges, and from previous attempts of others to measure posture objectively. The values obtained were treated statistically (using the partial correlations) and the combination of measurements chosen which gave the closest agreement with the criterion.[1]

The results indicated that only four measurements, properly weighted, would combine to give a posture grade corresponding to that of the composite judges' grade (Fig. 2):

The antero-posterior curvature in the thoracic spine (X_1).

The antero-posterior curvature in the lumbar spine (X'_1).

A combination of body tilt and segmental angulation (X_2).

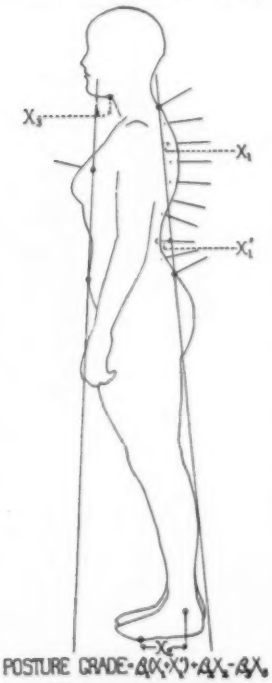

Fig. 2. Diagram showing location of points and lines used in grading the posture photograph. (By courtesy of the Research Quarterly.)

The carriage of the head in relation to the chest and abdomen (X_3).

Since the manner in which these measurements were made is essentially the same as that used now in the routine procedure, it will be described later when the technique of the method is discussed. The measurements are indicated, however, in Figure 2.

The proper weighting of the measurements to give the correct grade was determined statistically by means of the regression equation. The weights represent the relative importance which the judges as a group attributed to these four measures as factors in their grading. The curves of the upper and lower spine were found to be of equal importance and almost precisely eight times as significant in the estimation of posture as the measure of segmental angulation and body tilt, and approximately four times as important as the carriage of the head.

The final problem consisted of simplifying the mathematical procedure and eliminating the necessity of enlarging the original photographs. Three scales were made, the size of the graduations being determined by the relative weights for the measures. It will be readily understood that if one measurement is eight times as important as another, it can be given its proper weight if it is evaluated on a scale, the divisions of which are one-eighth the size of those for the second measure. Since the two curves of the spine were of equal importance, one scale sufficed for both. Scales for the spinal curves, segmental angulation and body tilt, and the carriage of the head were made inversely proportional to the actual weights found by the regression equation. The necessity for enlargement was avoided by making the size of the scales proportional to that of the small photographs taken in connection with the routine work of the department.

The method thus developed was found to be practical, precise, and expeditious. Briefly, the procedure is as follows: A five-inch photograph of the individual, with pointers attached and malleolus marked, is taken on photostat paper, developed immediately, marked, and slid under a glass on which the three scales are printed. The measuring and weighting are accomplished simultaneously, and the component parts of the grade may be read off directly and recorded in terms of scale units. The total of the components gives a numerical grade ranging from 1 (A+) to 25 (E—). Fig. 3 shows a routine photograph with the triple scale superposed; the brass frame holding the triple scale, with a photograph inserted, may be seen in Fig. 4.

That the method is precise is shown by the fact that fifty per cent of the grades predicted by the regression equation did not vary from the combined judgment of the specialists by more than two-fifths of a letter grade. Furthermore, of the eight hundred and thirty-four subjects used to complete the study, the letter grades coincided in four hundred and ninety-one cases, fell in the adjacent letter class in three hundred thirty-four cases, and in only nine grades was there a discrepancy of two letters. Compare this with the range of grades given an individual by the various judges:

Absolute agreement ..... 6 cases
Range covering two adjacent letter grades....293 cases
Range covering three adjacent letter grades...416 cases
Range covering four adjacent letter grades....120 cases
Entire range, "A" through "E" covered..... 3 cases

The disagreement among the judges was due for the most part to a difference in *level* of grading rather than to actual discrepancies in individual cases. The comparative severity of their judgments may be seen in the following tabulation:

	% A's	% B's	% C's	% D's	% E's
Judge 1	6.7	40.8	46.3	5.5	0.7
Judge 2	10.9	54.2	26.0	7.1	1.8
Judge 3	14.8	29.1	46.8	8.9	0.4
Judge 4	1.9	21.5	46.9	26.8	2.9
Judge 5	3.5	23.6	58.1	12.8	2.0
Judge 6	2.3	18.7	31.3	34.8	12.9
(Judge 6a	2.3	20.2	31.9	33.4	12.9)
(Judge 6b	3.8	17.9	26.7	33.7	17.9)
(Judge 6c	5.4	18.9	30.5	31.0	14.2)
Combined Judgment	6.7	31.3	42.6	16.0	3.4

Regardless of the difference in level, the fact still stands that for three individuals, the entire range of "A"

through "E" was included by the judges, whereas with the objective method the greatest discrepancies were in the nine cases for whom the grade was removed two letter classes from the criterion grade (combined estimate of the judges.)

The objective method eliminates not only discrepancies between the grades given by various individuals, but maintains a consistent level or standard for the letter grade ranges. It measures faults and merits impartially and prevents the basing of the entire grade on a single pronounced defect. Subjective grades are often unintentionally biased in this respect. Fig. 5 is a good demonstration of the objectivity of the method. The three photographs, showing consistently good posture over a period of nineteen months, have been graded 8.5, 8.5, and 9.5, all a grade of "B," by three different examiners.

Fig. 3. Posture photograph with triple scale superposed. The scales for the head and segmental angulation measure one unit for each division; that for the spinal curves, two. (By courtesy of the Research Quarterly.)

ROUTINE PROCEDURE

The photography room is four by twenty feet. At one end, where the student stands to be photographed, are four 1000-Watt lamps and a large safe-light overhead for the student's convenience when the main lights are off. Near the opposite end of the room, the camera is mounted on a rigid arm which may be swung back against the wall when not in use. The switches at the left for the main lights, and the sink, developing, fixing, and washing trays at the right are all within arm's reach of the photographer. Two safe-lights illuminate the camera and the developing trays.

The camera was made in the department and has been in use since 1926. It is loaded with a two and one-half inch by forty foot roll of photostat paper, allowing sixty photographs to be taken before reloading. With the 4000-Watt illumination, and full aperture, 0.1 second exposure time is sufficient.

Before the student enters the photography room, ten pointers are attached to the skin over alternate spinous processes and one to the sternum, and a bit of adhesive tape placed on the left external malleolus as described on page three. In the photography room, she stands in profile, as indicated by foot-prints painted on the floor, against a background of Turkey red flannel. A plumb line, hanging close to the background, serves to define the vertical in the photograph. The main lights are switched on and the exposure made. After the lights are turned off, the exposed length of photostat paper is drawn out and torn off by means of a cutting edge with which the camera is equipped, and the student's name recorded on the back. The negative is developed and fixed immediately under the observation of the student, and after a brief rinse, is blotted and given to her to examine and take with her to an instructor in an adjacent room. Here, the faults and merits of her posture, as shown in the photograph, are discussed with her, and posture correction given before triple mirrors. The photograph is then given a fifteen minute washing in running water, after which it is placed upon a drying frame covered with gauze. The procedure from the time the student enters the photography room until she is given her photograph requires less than two minutes.

Adjacent to the photography room are two grading desks, each illuminated by gooseneck lamps, and equipped with Bristol board and glass insets to serve as backing for the marking of the photographs. Brass framed grading scales, rigidly attached to the desks, are illuminated from beneath. The desks are hinged, providing a table for marking the photographs when lowered, or allowing a comfortable position for grading when raised at an angle.

The photographs are maked as follows (Fig. 3): With a number five dissecting needle, fine pricks are made at the angle between the lower margin of the jaw and the profile of the neck (A), the point of tangency that a vertical would make with the abdominal profile (B), and the center of the marker on the malleolus (C). Then with a pair of bow dividers with number ten needle points, adjusted to the length of a photographed pointer, the proximal ends of all the pointers are located and fine pricks made (D to E, F). With a dissecting needle and a metal straight edge, fine lines are scratched joining the proximal ends of the cervical and sacral pointers (DE), and the abdominal point and the proximal end of the chest pointer (FB). These lines are prolonged up-

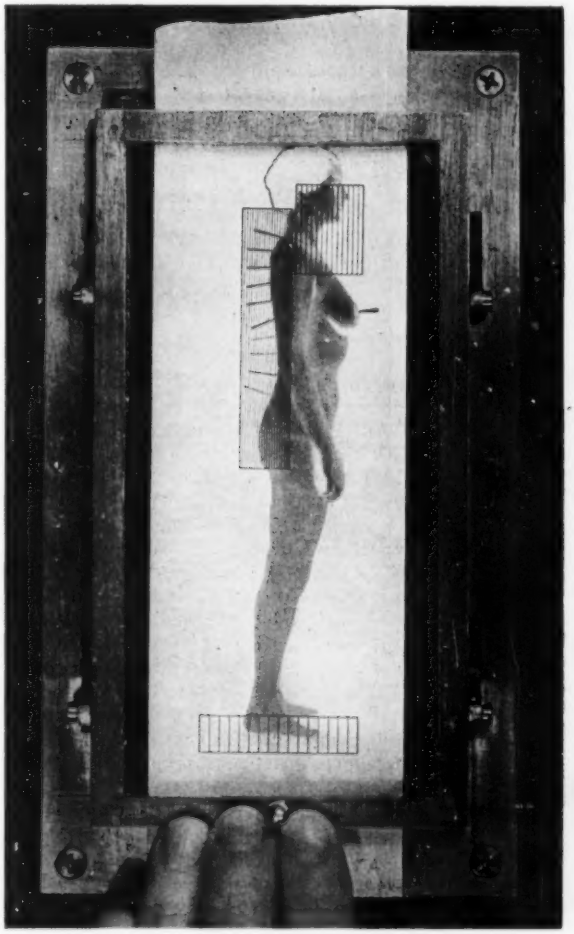

Fig. 4. Posture photograph inserted in brass frame which holds the triple scale.

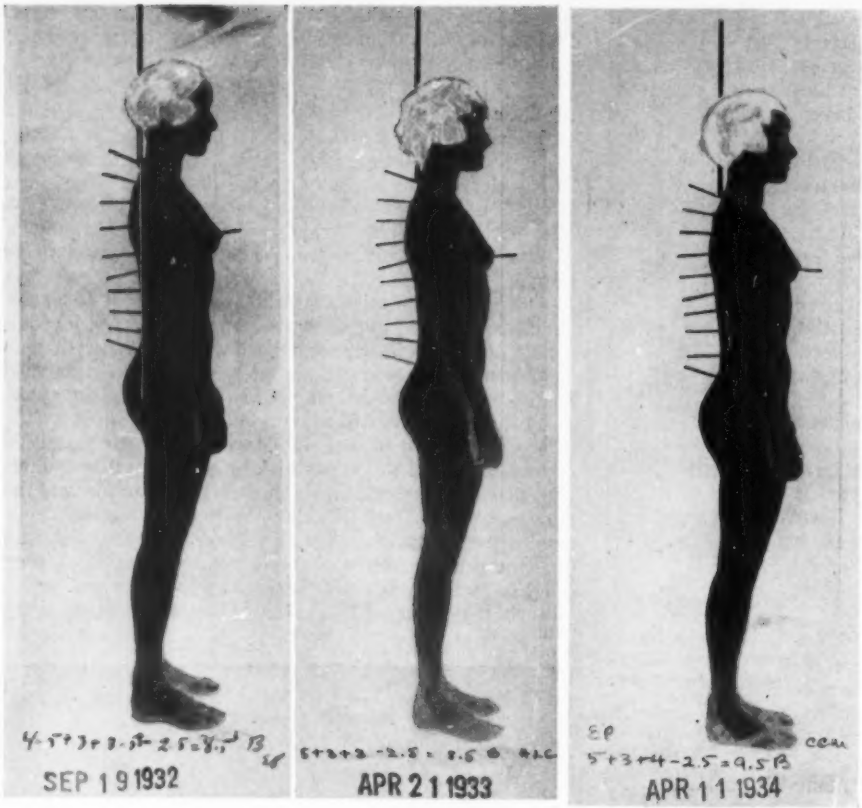

Fig. 5. A consistently good posture, showing objectivity of method of grading. The pictures, covering a period of 19 months, have been graded by three different examiners.

ward above the neck and downward below the foot level, and constitute the "back line" and the "front line" respectively. With a pair of proportional dividers, a fine prick is made at the point midway between the "front" and "back lines" at the level of the fifth metatarsal (G). The negative is then slipped under the triple scale and the grade read off. Perforations and scratched lines are favored for two reasons: they are readily detected against the light, and they may be made extremely minute and still be visible, hence maintaining a high degree of mechanical precision.

The four measurements, previously indicated, are made by counting the scale units as follows (Figures 2 and 3).

Thoracic curve: from the "back line" to the perforation indicating the greatest convexity of the dorsal spine (X_1).

Lumbar curve: from the "back line" to the perforation indicating the deepest concavity of the lumbar spine (X'_1).

Segmental angulation and body tilt: from the perforation on the malleolus to that marking the midpoint between the "front" and "back lines" (X_2).

Carriage of the head: from the "front line" to the perforation at the juncture of the jaw and neck (X_3). This value is negative if the perforation lies to the rear of the "front line," and positive (occurring only in cases of very poor posture) if the "front line" cuts the profile of the neck.

The algebraic sum of the four measurements gives a numerical value, which may, at will, be translated into a letter grade by referring to a table provided.

It should be noted that the "back line" does not invariably pass through the point of change of flexure of the spinal curves, and that very occasionally the thoracic measurement may include a portion of the lumbar curve, and vice versa. However, statistical study proved that the sum of the curves so determined was, as a factor contributing to the evaluation of posture as a whole, as valid as the sum of the true dorsal and lumbar curves. For this reason, and to save the time that would be required to determine the point of change of spinal flexure in all cases, the above definition of thoracic and lumbar curves were arbitrarily set up for the purposes of this method. As a matter of fact, the intersection of the "back line" with the line of the spinous processes coincided with the point of change of flexure in a great majority of the cases in this study. For special studies requiring the measurements from the change of flexure, a broken line may be substituted where necessary, and the curves measured with reference to it.

A 16 mm. motion picture film has been made showing the entire routine procedure with supplementary diagrammatic demonstration of the method of grading, and is available to institutions whose members are interested in observing the entire technique of this method.

PRACTICAL APPLICATIONS OF THE METHOD

That the method devised is superior for ordinary purposes to a subjective estimate cannot be denied. Before discussing its applications, however, let us review briefly its limitations. The profile view allows the judging of antero-posterior posture only, and excludes consideration of lateral curves or condition of knees and arches. It tests the excellence of a static position, and makes no claim to evaluate carriage. As applied at Wellesley College, all photographs are of "best standing," that is to say, the student's conception of what that position should be. Attempts made to test "habitual" posture, and to compare it with "best standing" position, have not met with great success. The degree to which a photograph of so-called habitual posture represents the ordinary inattentive pose depends to a great extent on the personality of the photographer in addition to her method of catching the student unaware.

No attempt so far has been made to define the "normal" or "ideal" posture, or to discriminate between them. In more than one respect, they defy definition.

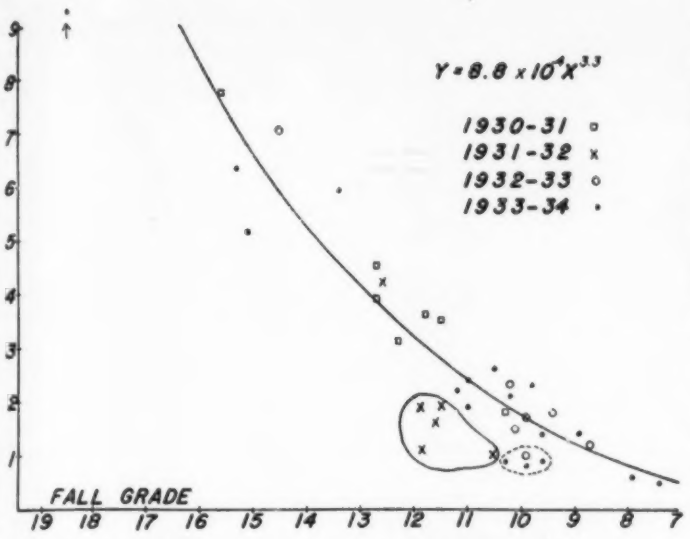

Fig. 6. Relation between fall grade and improvement: freshman activity groups. (By courtesy of the Research Quarterly.)

When the development of the method was first undertaken, each judge was requested to indicate her choice of one of the eight hundred and thirty-eight photographs most nearly representing the ideal posture. No two judges made the same choice, and, although all these students were given excellent grades by the objective method, they were by no means consistently of one posture type. How nearly the posture *in toto* approaches this "ideal" can be gauged by the numerical value given it by the objective method.

Whether or not a truly quantitative definition of "ideal" posture, on the basis of visceral function, motor efficiency, and aesthetic considerations, can ever be established, we should at least avoid confusing the "ideal" with the average. Average dimensions have an "ideal" survival value for creatures in a state of nature, but not necessarily for human beings living under rapidly changing artificial conditions.

One of the useful services performed by the objective method is that of offering a partial basis for classification for activity work in physical education classes. In the fall of the year, all students are given four examinations. From the results of these, with due allowance for the student's choice, the activity work is determined. Participation in light, medium or strenuous activities depends upon the results of the medical and physical examinations; the orthopedic examination including the posture photograph indicates the need for individual gymnastics or brief after-class periods of special posture training; the motor ability test determines whether a student shall be restricted to a limited choice between two systematic body training activities or be allowed the free elective privilege. A minimum posture standard of C- (15 on the 25 point scale) has been set up as one of the requirements for completion of the undergraduate courses in physical education and an attainment of at least B- (10) for the professional students.

In connection with the entering examinations, it is gratifying to note the apparent gradual improvement in posture, as witnessed in the averages of succeeding classes. The general upward trend may be indicative of improved methods and greater success in posture training in the preparatory schools and camps.

The method has proved a valuable working tool for special studies, the two most interesting of which led to the development of the Par Curves of improvement and the Pameter. The former was the result of an effort to determine the influence of specific activities on posture improvement. The study was started during the first year that the method was employed, the work being based on the records procured at the time of the routine fall and spring posture examinations.

In the freshman year, the interval between the initial or fall examination and the taking of the second routine

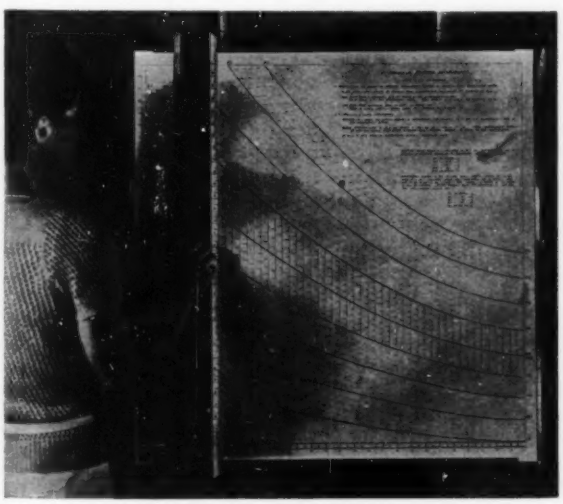

Fig. 7. The Pameter. This side is used for measuring the posture achievement of individuals.

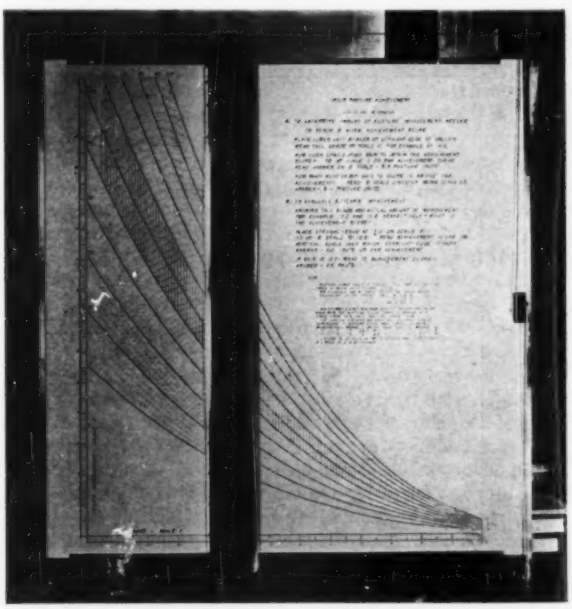

Fig. 8. The Pameter. Reverse side for measuring the posture achievement of activity groups.

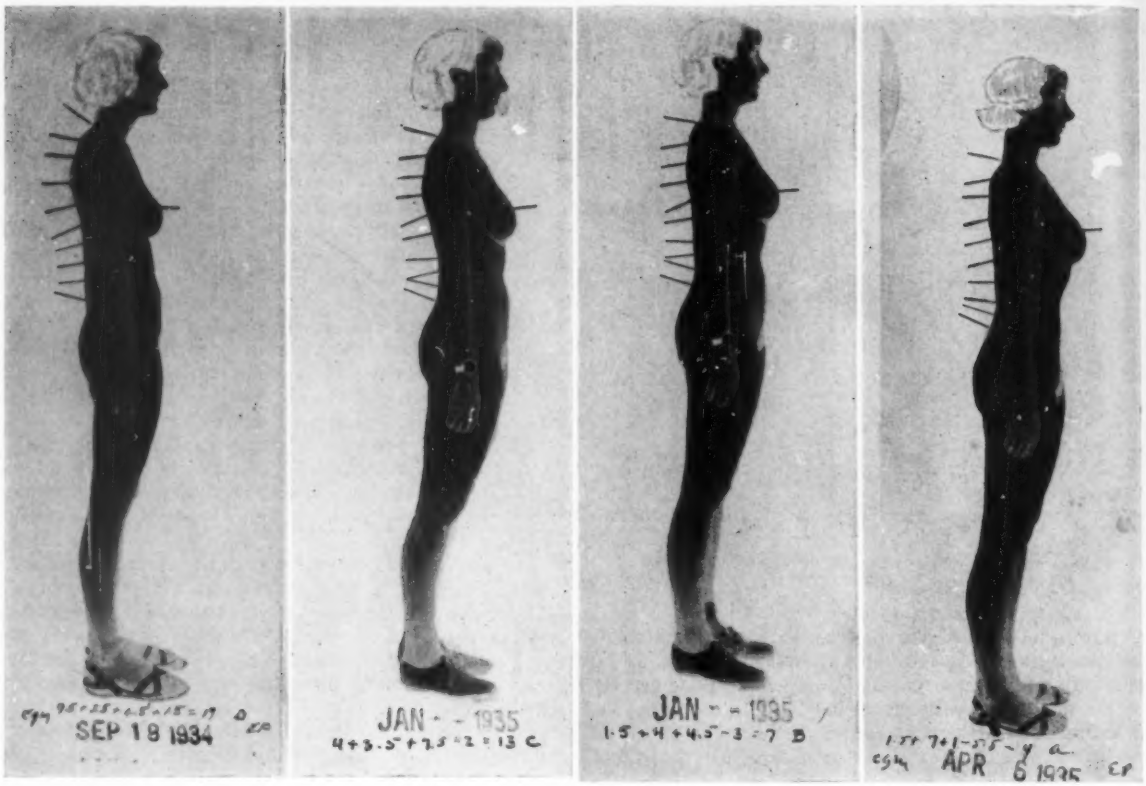

Fig. 9. An example of freshman improvement during an interval of 7 months. Photographs are graded, respectively, 19 (D), 13 (C), 7 (B), and 4 (A).

photograph in the spring includes a six weeks' season of outdoor sports and sixteen weeks of indoor activity. Each year for four years, the average improvement was computed for freshmen grouped according to indoor activity—fundamental gymnastics, folk dancing, individual gymnastics, modern dance, restricted activities, riding, and tap dancing. During this time, the regular curricular work and the incidental posture training normally associated with it proceeded without any experimental modification with the exception of the year 1931-32, when all instructors were asked to refrain from any emphasis on posture as such, in order to determine the intrinsic values of the various activities in this respect. This request of course did not apply in the case of individual gymnastics. The average group improvement plotted against the average fall grade for the different activities indicated a well defined curvilinear trend expressed mathematically by a curve shown in Figure 6.[2] The fact that this relationship is expressed by a curve and not a straight line demonstrates that the improvement during the year is more than proportional to the poorness of the initial grade. There is nothing remarkable, of course, in finding that people who start on a level of skill which is close to their attainable maximum cannot be expected to improve as much as those who start on a lower level. The interesting thing is that the same mathematical relationship holds for virtually all groups regardless of the nature of the activity (including individual gymnastics), the size of the group, or the instructor in charge. The fact that all the groups for 1931-32 in which posture emphasis was omitted fall below the achievement for other years, whereas individual gymnastics for that year holds its place on the curve, indicates that supplementary posture training in connection with regular class activity is measurably effective.

The same procedure, applied to improvement of the individuals in the freshman classes, led to the development of a second curve. These curves, representing the average attainable improvement for each initial grade, we have called Par Curves. During the past year, they served the practical purpose of determining whether an individual (or group) attained, exceeded, or fell short of the improvement expected, and of indicating in a general way to each instructor her effectiveness in posture training, based on the attainment of her students.

The Par Curves furnish a rough means of grading students as average, above, or below average in their attainment. The problem next presenting itself was that of finding a unit to be used in measuring the achievement for those starting with different fall grades. Obviously, to use the points gained on the twenty-five point scale would be misleading and unfair. Consider two cases, each gaining one point: the first, having a fall grade of 3 (A), would improve thirty-three per cent; the second, with an initial grade of 25 (E-) would improve but four per cent.

The Parameter, or Posture Achievement Measurer, is a device—virtually a slide rule—for measuring and grading the posture achievement of individuals or groups, and for evaluating the success of the various instructors' posture training methods (Figures 7 and 8). It may be used by students early in the year to discover what their improvement should be to reach par by the end of the season, or may be manipulated by them as a self grading

device. The contrivance is two-faced with the scales for individuals on one surface and those for activity groups on the reverse side.

The Pameter makes use of a sliding scale in which the unit of achivement lengthens for the poorer groups which have greater room for improvement, and shortens for groups which are already very close to their maximal attainment. Above and below the Par Curve, which represents average attainment for each fall grade, are ten zones, wide at the poor end of the scale and narrower as the capacity for improvement grows less. The measuring of attainment, in terms of Posture Achievement Units (PAU's) is simply and quickly accomplished by sliding an attached rule to the designated fall grade marked on the base line of the scale, reading upwards on the rule till the improvement is located, and reading the achievement grade from the zone adjacent to the latter figure.

Figure 9 shows an example of freshman improvement during the interval between the fall and spring examinations. The first, second and fourth photographs in the series represent the student's conception of "best standing" position at the time the pictures were taken. These were graded 19 (D), 13 (C), and 4 (A), respectively. The third, graded 7 (B), was taken on the same date as the second, but with help from the instructor. The student's Posture Achievement Score in April, 1935, was 70 PAU's (where 50 represents par), or A_+ in terms of letter grades. Note the distinction between the unit of improvement, one point on the posture grading scale of 1 to 25; and the unit of achievement, which varies with the excellence of the grade with which the person starts. For example, a person with a grade of 8 at the start of training needs to improve only one posture improvement unit to reach par achievement; whereas a person with a grade of 18 must improve 7 posture improvement units to reach par achievement.

The Par Curves and the Pameter were developed from data for freshmen only. Pending the completion of studies now in progress to determine standards for sophomores, we recommend the use of the freshman curves for this group. A prospective study of the junior class should prove of value in determining in a general way the carry-over of previous training into a period when no supervised posture work is required.

1. A detailed account of the statistical development of the method, and the equipment necessary for the routine procedure, may be found in the *Research Quarterly* of the American Physical Education Association, October, 1932.

2. For the statistical development and practical uses of these curves, readers are referred to the *Research Quarterly* of the American Physical Education Association, March, 1935.

Bone Regeneration and Mobilization in Fractures

Merrill K. Lindsay, M. D.

It seems reasonable to assume that the process of tissue regeneration is instituted and supported by the physical and chemical reactions resulting from the juxtaposition of the elements involved in the phenomena following injury. To illustrate this we may examine the conditions resulting from the application of a force which exceeds the elastic limit of any bone. The first effect is a break in continuity which may also involve to a greater or lesser degree the soft tissues surrounding. Following this, there is hemorrhage which occupies the fracture site and infiltrates the traumatized area. Vasodilatation and engorgement of the tissue spaces combine with the effusion of blood to produce swelling. In due course, a coagulum is formed of the blood between the fragments, and into this buds of granulation tissue, arising from the Haversian systems at the ends of the fragments and from other surrounding connective tissues, push their way to form a structural organization. With the coagulum transformed into an embryonic type of connective tissue, there now appears a most important and interesting phase of the regenerative process—that of calcium deposition.

Granulation tissue or the embryonic type of connective tissue consists of a collection of fibrillae and cells supported by a matrix or homogeneous ground substance without any definite structural adaptation or directional arrangement of the fibrillae and cells. Adaptive changes occur progressively in such a tissue, transforming it into any one of the recognized types of connecting or supporting tissues. In the formation or regeneration of bone, the character of the adaptive change which is present in the tissue undergoing calcification determines the quality of the new bone. Thus, in the repair of fractures, if the tissue undergoing calcification between the fragments has become essentially fibrous, like scar tissue, the predominance of the fibrous elements will limit the calcium deposition and result in a weak and non-resistant callus. The process of calcification limits further differential change in the connective tissue framework and is itself conditioned by the degree to which this differentiation has previously progressed.

Coincident with the foregoing phenomena is found a progressive calcium resorption of the ends of the fragments which progresses under normal conditions until their identity is lost in the new callus. It may be that this absorbed calcium is reprecipitated to form the new bone since it would constitute a source of increased local concentration of that element.

It has been demonstrated experimentally in animals that in normal bone regeneration there is demonstrable calcium present on the sixth day. It may be found as small granules in the tissue section and there is also, at this time, an added quality of resistance and rigidity between the fragments. Studies conducted on the breaking strength of healing fractures in rats following a constant fracture show no measurable strength before the sixth day. From this time on to the twenty-fourth day both the strength and size of the callus increase. From the twenty-fourth to the thirtieth day both the strength and size of the callus decrease. After the thirtieth day the callus continues to decrease in size and the strength gradually increases again until it equals that of the unbroken portion of the shaft on about the forty-eighth day.

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These figures are based on a study of more than two hundred and fifty young adult rats which had shown a normal growth curve and which were fed on adequate and balanced diet. Young rats were found to develop a maximum callus at a considerably earlier period and dietary deficiencies and substitutions were found to alter the healing rate. Published experimental studies indicate that the rate of bone regeneration is the same for all animals including man.

Restoration of function is the primary object of all fracture treatment. There is probably no method in anything approaching general use which does not have some virtue and it would seem that if experience is to teach us anything, it should ultimately enable us to apply the most effective measures at our disposal to meet the varying requirements of each fracture case as it is presented.

One way of approaching this ideal is to reduce the principles of all methods to their simplest forms and reassemble them to meet the requirements in the individual case. On this basis, we might consider the entire subject under four general headings; mobilization, immobilization, traction and operative procedures.

It frequently happens that two or more general methods are applicable in a single case and for that reason the discussion of any single method would be unsatisfactory without mentioning all methods, at least in principle.

On this occasion, we are principally concerned with immediate or early mobilization as a general method of treatment and while there is a relatively large number of cases in which it may be used as the sole or chief method, the principle of mobilization finds a place in the conduct of practically all fractures involving extremities after other methods have served their purpose.

The wide-spread impression that most fractures require at least a preliminary period of immobilization is based on sound mechanical principles and certainly also on clinical experience. However, it is also generally conceded that in order to accomplish this the soft tissues must be neglected. It should be remembered that where immobilization or disuse produces definite and progressive calcium absorption from the bones, it causes even more rapid structural changes in the soft tissues. The atrophy of muscle, while not associated with a reduction in the actual number of the cells, is caused largely by a diminution in the size of the cells. Coincident with the structural changes in soft tissue occur functional changes of more or less serious import. These are loss of elasticity and contractility. No matter in what position an extremity is immobilized, one or the other of the opposing groups of muscles will shorten and the opponents will be weakened. These changes in the soft tissues frequently not only prolong the disability after there is solid union between the fragments, but in some cases result in permanent loss of function. While permanent loss of function might seldom result solely from soft tissue changes, it has resulted from excess callus and bone proliferation about the joints which is caused by trauma inflicted in an effort to overcome contractures.

From a purely physical or mechanical standpoint there should be a wide variation in the requirements for immobilization in the many different types of fractures and it is for the purpose of attempting to establish a practical correlation between immobilization and mobilization that this discussion is undertaken. Since there is much to be gained in our objective—the early restoration of function—by preventing or minimizing the soft tissue changes of disuse, it is of much interest to discover the types of fractures in which immediate or very early mobilization may be employed without prejudice to the process of bone regeneration. There are many things to be considered in the selection of cases for this form of treatment and these should include a careful consideration of the injury to soft tissues including nerves and blood vessels. Defects in bone vary widely in apparently similar fractures and it is needless to say that no hard and fast rules can be formulated governing the selection of cases. However, a consideration of general principles combined with the exercise of judgment based on experience will open up a relatively large field for the application of this method.

In general it may be said that early mobilization is indicated in those cases in which there is either no gross deformity or where gross deformity is not likely to result from the forces employed in obtaining motion. Incomplete and subperiosteal fractures of the shaft and complete and incomplete fractures in and about the joints are most likely to fall into this classification. In addition to the above there are cases where gross deformity or displacement may be corrected and the position maintained with or without internal fixation which may be included. Fractures of the patella and olecranon are common examples of cases where reduction and internal fixation will permit early mobilization. It must not be assumed that neglect or failure to provide suitable protection is advocated in this form of treatment. On the contrary much closer supervision and care to prevent displacements and deformity is required where early mobilization is used than in cases which are treated by other methods. Early motion, unlike the active motion used after there is fixation of the fragments by callus, is only to be undertaken under careful supervision and the part must be protected against injury and deformity by suitable splints and dressings between treatments. In case of the wrist a moulded splint; the elbow, fixation in flexion (except fractures of the olecranon); the shoulder, a handkerchief sling, and an axillary pad and circular bandage; the knee, a moulded ham splint, etc.

Returning briefly to the injury to soft tissues in determining the type of treatment, it may be noted that rarely are compound fractures suitable for early motion. In some cases where a thoroughly satisfactory debridement and complete closure are accomplished with satisfactory relation of the fragments, it may be used. Where neurological changes occur as indicated by paralysis of muscle groups, the treatment should be modified so as to include support in a relaxed position of the affected muscles, such support to be effective at all times between treatments. The prevention of the loss of contractility and elasticity is of paramount importance because in such cases there is the additional factor of the loss of innervation to complicate further the muscle imbalance. Injury and obstruction to the circulation must be compensated for by a temporary compromise in position between treatments. For instance, in a fracture of the elbow a position of acute flexion may be indicated to maintain a correct relation of the fragments but for the first few days or until a sufficient reduction of the engorgement of the lymph spaces can be accomplished by massage and motion, it is necessary to limit the flexion to the point where the circulation is adequate in the extremity.

The objective which has been attempted in the immediate and early mobilization of fractures has been to develop a method which would allow the widest range of function for the soft tissues and at the same time maintain an unchanged relation of the fragments.

There has been some misconception of the actual technique of applying massage and relaxed motion due

to the use of the term "massage" in connection with it. The massage used is not the application of pressure or force of any kind, but a gentle rhythmic stroking, which, in order to be effective, must be entirely soothing and agreeable to the patient. The purpose of this gentle massage is to relieve muscle spasm, and when properly applied will be found an extremely effective measure in cases where early mobilization is indicated. The relief of muscle spasm has several clinical advantages, inversely proportional to the length of time which has elapsed following the injury. If accomplished before the swelling has become pronounced, it will largely tend to prevent it by lessening the flow of blood to the part and by improving the return circulation. At this time it will in some cases enable one to accomplish minor adjustments of the fragments painlessly and without an anesthetic. If marked swelling has occurred, the massage may be used for its control and reduction, and also for the relief of pain. Later, it permits of motion in the neighboring joints without displacing the fragments. In case the fracture involves a joint, the massage makes early painless motion possible without the untoward effect of injuring newly formed vascular structures and causing more hemorrhage with the resultant increase of obstructing callus about the joint.

The type of motion used in immediate and very early treatment before there is any appreciable fixation of the fragments by callus is essentially that caused by the action of gravity on the relaxed extremity.

In attempting the use of early motion, the first essential is relaxation, and this should be attained before any motion is started. Very young children and elderly patients are most difficult to relax and the first treatment is therefore not always as satisfactory as the subsequent treatments. In the very young, early motion is least essential on account of the greater elasticity and flexibility of the tissues. Contracture of physiological tissue occurs as the result of immobilization and this condition is perhaps the greatest obstacle to the return of function in fracture cases.

The Management of Fractures Involving the Knee and Ankle Joints

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and

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In the opening paragraph of their chapter in "Principles and Practice of Physical Therapy," Lindsay and Brown make the significant statement that the object of fracture treatment is primarily the restoration of as nearly normal function as possible. Many physicians who treat fractures are interested only in obtaining union and are inclined to discharge the patient as soon as the roentgenograms show that the bones have united. As a result of this tendency not to follow up patients, even those who deal with large groups of fractures in this manner do not visualize the entire problem. Pain and disability may persist for months or years with permanent changes in the joints which produce symptoms of increasing stiffness and an arthritis-like pain in those cases where the fracture line extends into the weight-bearing joint.

Few reports of series of cases showing end results of fractures into the knee or ankle joint have come to my attention. An end result can not be determined in less than one to five years after union has occurred. The first important considerations in the treatment of fractures of any type are accurate reduction and firm bony union. The surgeon should add to and follow this with a program for his patients which helps to minimize the amount of residual pain, swelling, stiffness, and concommitant limp which may result from injury to the muscles, ligaments, or capsule of the joint, in addition to the fracture. The result of an injury sufficient to produce a fracture always causes some disturbance in circulation which is characterized by immediate swelling and the extravasation of blood from the injured blood vessels. Further local collapse of the peripheral circulation may result from long wearing of a plaster cast. When the fracture line does enter the joint, although the reduction may be accurate so that the joint surfaces are smooth, swelling, stiffness, and circulatory disability may persist for a long period of time after union has been obtained.

Fractures of the extremities which do not involve joints may be safely treated by the method described by Böhler in which the patients begin active walking in a padded and well supported cast after absolute fixation of the fracture. If the fracture enters the joint, we prefer a long period of complete rest for the extremity. Early functional use should not be emphasized to the point of starting weight bearing on a joint in which there has been definite intraarticular injury, inaccurate alignment of the joint surfaces, or in which a roentgenogram shows rough callus which may traumatize the cartilaginous surfaces of the joint.

The unsupervised patient can not be expected to follow accurately the instructions about post union care of the limb which should give the optimum degree of normal function. Relaxed motion in the early mobilization of fractures and dislocations, as advocated and carried out by Lindsay and Brown, is especially applicable to fractures which involve joints. Relaxed motion, with the muscles about the injured joint completely at rest, does not traumatize the joint surfaces even though

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Case I, Fig. 1A. *October* 16, 1933. *Fracture of proximal end of tibia extending into knee joint.*

excess callus or irregularity in the line of fracture may be present. Forced motion, on the other hand, such as that which might come from early weight bearing or forced stretching, may, in certain instances, produce additional and permanent pathological changes in the joint.

With these facts in mind, a study was made of a group of fourteen patients, constituting a cross section of the cases, who came to the University of Chicago Clinics for treatment of fractures which involved the ankle joint, and nine patients with fractures into the knee joint. Neither supervised relaxed motion nor physical therapy of any type has been used routinely for patients who are admitted to the general surgical service. The end results noted for these patients as shown in Tables I and II are from five months to five years after the fracture had occurred. In ten of the fourteen patients who had sustained fractures involving the ankle joint, pain, loss of motion, or instability persisted and caused disability of varying degrees. Two of the four patients who made good or normal functional recovery were given heat, massage and relaxed motion from the time that the cast was bivalved and the roentgenogram showed that the fracture was uniting. In one patient, K. S., the fracture did not extend into the joint but ankle joint pain and disability were so marked during the first few weeks after the cast was removed that the patient requested heat and massage and supervised motion and this was carried out with good functional recovery, although the patient continues to have some aching in this joint during wet, cold weather.

Case II, Fig. 2A. *Fracture of the shaft of the fibula and of lateral malleolus of the tibia extending across the epiphyseal line and into the ankle joint.* (12-21-30)

Of the nine patients with fractures of the proximal end of the tibia which extended into the knee, five have had persistent disability and in only four (less than 50%) was there approximately normal functional recovery. Three of the four who made satisfactory recovery received physical therapy from the day that the cast was first bivalved. In two of these cases such physical therapy was begun before there was solid bony union, but evidence of fibrous union was present. In the group of six patients who received no physical therapy, only one made a satisfactory recovery.

Case I, Fig. 1B. *Roentgenogram taken* 2-14-34, *four months after fracture and two months after relaxed motion was begun.*

The following case reports are typical of those which we have studied and illustrate two patients who received physical therapy and made good functional recovery and two in which no physical therapy was used who have had some deree of persistent disability, one of them requiring arthrodesis of the ankle, a procedure which has been recommended by Gallie for the treatment of fractures into weight bearing joints in which pain persisted after union of the fracture had occurred. Case I.

M. B., aged thirty-two, female, sustained a fracture of the tibia which extended into the knee joint, October 14, 1933. (Fig. 1A). The reduction was considered to be satisfactory and plaster cast immobilization was used for sixteen days. The cast was then bivalved and physical therapy, consisting of heat and massage and relaxed motion, was begun. This was carried out daily at first, then each second day, and during December only two treatments were given. Supervised exercises were given in the tank with the temperature of the

Case II, Fig. 2B. *Four years later,* 10-19-34, *showing defect in articular surface of tibia at site of healed fracture.*

water kept at 90°. The patient was last examined one and one-half years after the fracture and at that time she had complete normal range of motion with normal painless function. (Fig. 1B.)

Case II

M. L., aged fourteen years, female, sustained a fracture of the left tibia and fibula which extended into the weight bearing surface of the ankle joint. The fracture was accurately reduced and the patient was treated by plaster cast immobilization. (Fig. 2A). The cast was removed one month after the fracture and the patient was advised to continue some massage and passive motion at home but no physical therapy was given under trained supervision. There was no control of weight bearing, although the patient continued to use crutches for an additional period of ten days. The patient had good functional use of the ankle until October, 1934, almost four years after the fracture had occurred, when she began to complain of pain in the ankle joint. (Fig. 2B). Roentgen rays showed slight irregularity on the ankle joint surface of the tibia compatible with the clinical impression of traumatic arthritis. After several weeks of strapping of the ankle, heat and massage, the disability subsided.

Case III.

S. R., aged thirty-two, female, sustained a fracture of the right tibia which extended into the ankle joint, May 24, 1931. A plaster of Paris cast was used for immobilization. No physical therapy was advised. Pain in the ankle began with weight bearing but was present also during inclement weather or when she was fatigued from more than her normal degree of activity. This disability had persisted for more than two years when she came to this clinic in October, 1933, and the roentgenograms showed rough joint surfaces. A diagnosis of traumatic arthritis was made. (Fig. 3A). Arthrodesis of the ankle joint was advised. Operation for arthrodesis of the ankle, and correction of a varus deformity, was carried out on October 25, 1933. This operation was successful in obtaining fusion between the tibia and the astragalus and in improving the appearance of the ankle. The patient has been completely relieved of pain and walks with little apparent disability. (Fig. 3B).

Case III, Fig. 3A. *Deformity of the ankle as the result of old fracture of both malleoli with inadequate reduction.* (10-24-33)

Case III, Fig. 3B. *Roentgenogram,* 12-21-33, *six weeks after an operation for correction of deformity of the ankle and arthrodesis of the tibio-astragalar joint.*

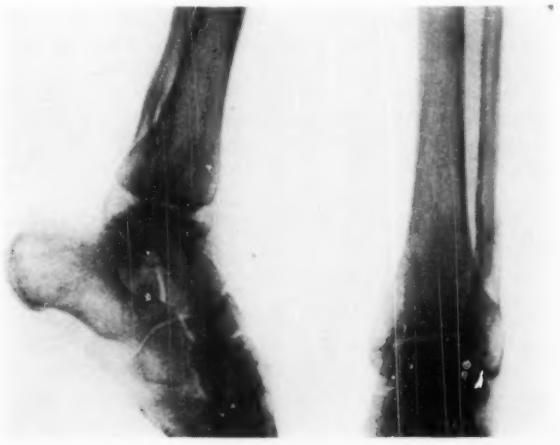
Case IV.

I. C., aged forty-nine, female, came to this clinic as an emergency February 11, 1934. Examination revealed a fracture dislocation of the left ankle. (Fig. 4A.) This fracture was reduced under local anaesthesia. The plaster cast was removed March 15, 1934, five weeks after the injury and physical therapy was begun. This consisted of heat and massage and of relaxed motion which was continued three times each week for a period of approximately two months. Weight bearing with crutches was permitted eight weeks after the fracture and two weeks later the plaster shells were discarded. She was last examined May 17, 1935, one year and three months after the fracture. (Fig. 4B.) At this time she had a normal range of motion and normal painless function.

DISCUSSION

Lindsay's statement that "motion never interrupted

Case IV, Fig. 4A. *Roentgenograms, taken* 2-11-34, *of the left ankle showing fracture dislocation. The articular surfaces have been injured in the direct weight bearing region.*



Case IV, Fig 4B. *Roentgenogram which was made May* 17, 1935, *one year and three months after fracture. Alignment of the articular surface is satisfactory. There is no evidence of a traumatic arthritis revealed by these roentgenograms.*

is motion never lost" applies most fittingly to fractures of joints. He has dared to begin physical therapy in some of his cases of fracture into the knee joint within twenty-four to forty-eight hours after the injury occurred. We feel that the reduction of the fracture must be accurate and that it should be securely immobilized until at least firm fibrous union has been obtained. Certain types of fractures into the knee joint can be moved with safety, but some of the fractures which we have seen could not be held in a position of accurate reduction without the restraint of the cast. We believe that most cases of non-union have been due as much to failure to immobilize as they have been to poor reduction of the fracture. Surgeons can not honestly "pass the buck" to the physical therapist and ask her to make complete amends for poor surgery in the early handling of fracture cases. (Fig. 5.)

We are quite in accord with Lindsay in the handling of the fractures of the ankle where he is willing to defer motion until there is fixation of the fragments by callus but, even in those cases, we begin relaxed motion from one to three weeks before active motion is thought to be indicated.

In all types of fractures of the lower extremity, and particularly in those which involve the joints, an attempt is made to encourage the patient from the very

TABLE I

FRACTURES INTO THE ANKLE

Patient	Age at Time of Fracture	Sex	Location of Fracture	Date of Fracture	Last Examination	Physical Therapy	Remarks
W. K.	37	M	Distal tibia and astragalus.	11- 8-32	2- 2-34	No	Pain. Not totally disabled.*
M. L.	14	F	Distal tibia and fibula.	12-21-30	11- 8-34	No	Recent attacks of arthritic pain and swelling.
S. J.	43	F	Distal tibia and fibula.	3-24-32	5-31-35	Yes	Good recovery.
V. B.	42	F	Distal tibia.	6-10-33	5-31-35	No	Pain persists.* Admitted 15 weeks after fracture.
C. C.	43	F	Distal tibia and fibula.	1-17-30	5-31-35	No	No disability
K. S.	30	F	Distal tibia and fibula.	1-17-30	5-31-35	Yes, late	Painful until physical therapy, then good recovery, slight discomfort in bad weather.
C. B.	45	M	Distal tibia.	6-13-31	4-13-32	No	Pain and limitation of motion.* Admitted four months after the fracture.
J. V.	42	M	Distal tibia.	Jan. '29	12-11-30	No	Traumatic arthritis, pain.*
I. C.	49	F	Distal tibia and fibula.	2-11-34	5-17-35	Yes	Normal function.
M. T.	50	F	Distal fibula and tibia.	10- 2-33	4- 5-34	No	Good recovery after five months.
R. S.	42	M	Multiple tibia and fibula and ankle joint.	10- 1-28	3-15-34	No	Painful ankle 6 years after. Late union shaft of tibia.*
S. R.	32	F	Distal tibia and fibula.	5-24-31	1- 4-34	Yes, after arthrodesis	Pain and disability. (Ankle arthrodesis performed.)*
B. Mc.	43	F	Distal tibia and fibula.	Jan. '30	1-30-31	No	Pain and disability.*
A. B.	52	F	Distal tibia and fibula.	4-28-34	2- 1-35	No	No complaint except slight swelling.

*Old at time of admission to University of Chicago Clinics.
Total cases, 14.
Persisting disability, 10; none of these received physical therapy until late.
Good functional recovery, 4. Two of these had physical therapy early, one late.

TABLE II

FRACTURE INTO THE KNEE

Patient	Age at Time of Fracture	Sex	Location of Fracture	Date of Fracture	Last Examination	Physical Therapy	Remarks
M. B.	32	F	Proximal tibia.	10-15-33	1-28-35	Yes	Good function.
E. H.	55	F	Proximal tibia.	5- 5-29	6-16-30	No	Limited motion, difficulty in walking.* Admitted 13 months after fracture.
R. B.	44	M	Proximal tibia.	11-22-33	7-16-34	Yes	Walks well.
H. P.	42	F	Proximal tibia.	Mar., 31	10- 6-34	No	Knee gives way, patient falls.*
J. M.	40	M	Proximal tibia.	9-16-32	4- 5-33	No	Limitation of motion.* Admitted 3 months after fracture.
C. H.	51	M	Proximal tibia.	8-19-33	5-21-34	No	Ankle painful, much swelling and stiffness in knee and ankle.
E. Q.	29	M	Proximal tibia.	10-27-34	1-19-35	No	Motion in knee good.
D. H.	52	F	Proximal tibia.	12-20-30	6-10-31	Yes	Excellent motion, knee and ankle.

*Old at time of admission to University of Chicago Clinics.
Total cases, 9.
Persisting disability, 5; none of these received physical therapy.
Good functional recovery, 4; three of these received physical therapy.

first day to move the toes as often and as freely as possible. In order to make this more practicable, the cast is cut away on the top of the foot to above the metatarsal-phalangeal joints. The patient is reminded each time that rounds are made that he has nothing else to do and should concentrate as much of his attention as possible upon exercising these toes. The toes are controlled largely by muscles in the calf of the leg and this exercise serves as a type of massage and helps to maintain tonus and circulation throughout the extremity.

Fig. 5A. The end result of a poor reduction of a fracture of the proximal end of the tibia into the knee. This joint is unstable. (*H.P.*, 9-26-34)

CONCLUSION

1. Physical therapy may be utilized as an important adjunct in restoring normal function in the joint which has been injured by fractures which extend across an articular surface.

2. No amount of physical therapy can entirely correct the shortcomings of the surgeon as evidenced by a late or poor reduction or an ineffective immobilization.

3. Physical therapy not only improves the regional circulation but helps to increase the tonus of muscles which have been weakened by injury and disuse, aids in mobilizing joint structures which may be stiff from adhesions within the capsule or contractures about it, and encourages the patient.

4. Close cooperation between patient, physical therapist, and surgeon is necessary to minimize time, pain and disability and to insure the best end results in the treatment of fractures, especially of those fractures which enter weight bearing joints.

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Muscle Testing of the Abdominal Wall

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In a contribution of *Muscle Testing*, presented in the American Journal of Surgery, December, 1927, I discussed charting of strength tests of muscles in poliomyelitic and other conditions, in which definite clinical graduations can be represented numerically. Studies of muscular balance of trunk muscles in paralysis and scoliosis, which led to the development of my use of fascial transplants, made my previous method of recording their strengths seem inadequate to give the proper picture of imbalances. Flexion and extension of spine, and side bending, I registered as nearly as possible according to the scale applied to the more intrinsic action of extremity muscles. Recognizing that even in the extremities, the independent action of single muscles can only in isolated instances be estimated with any degree of accuracy, I felt that the charting of trunk muscle function separately might be inaccurate. But, as I progressed in my observations of the totally, or partially paralyzed abdominal musculature, I decided to record my results graphically. It is a material aid in a busy clinic to have a reasonably clear written idea of the muscular imbalance which helps to clarify the understanding of the mechanism of deformity existing, in process, or prospect of developing.

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While no actually isolated muscle action can be provoked by various movements, certain very definite information as to some of the key muscles involved can be elicited. For instance, head raising, with or without resistance, from the supine lying position, actuates the rectus abdominis primarily, and all the other adjacent muscles secondarily. The presence, or absence, of the well known Beevor's sign (umbilical movement sign) will be definitely positive if either upper or lower sections of internal or external obliques further modify this sign by deviating the umbilicus to one side or the other, if there is unilateral imbalance in their action.

I have modified my method of recording, as mentioned in the article *Plastic Repair of Paralysis of Abdominal Wall*,[1] so that somewhat finer grades of weakness or strength can be shown. On a chart of the lower trunk, I represent the normal estimated 100 per cent strength by three parallel lines; approximately 50 per cent strength by two parallel lines; 25 per cent by one line; proportionately half grade by a broken line; uncertain, by a line of question marks; and definitely inactive by a line of crosses. These marks correspond to the numerical gradations given in the article on muscle testing, as follows:

Identifying Sign Lovett Method.	Lowman Numerical Scale	Percentage.
Normal	9	
Normal minus	9—	85 to 100%
Good plus	8+	
Good	8—	75 to 85%
Good minus	7 to 7+	
Fair plus	6+	60 to 75%
Fair	6— to 6	
Fair minus	5—, 5, 5+	40 to 60%
Moderately active but weak	3+, 4—, 4	20 to 40%
Definite contraction, but not strong or continuous	2+, 3—, 4	10 to 20%
Indefinite, uncertain, or mere fibrillation	1— or 1	10%
Inactive	0	0%

If the same technician always makes the check, she is soon so skilled and dependable that the surgeon will obtain a better idea from her chart, of the abdominal wall imbalances, than by testing them himself. Because of the depth of many of the muscles from the surface (especially in stout persons) the grading can be only an estimate, but the repetition of check under the same conditions by the same technician usually gives a relatively true picture of the imbalance.

In grading abdominal muscle strength, the technician must use a more or less imaginary ideal of the supposed normal for any given case, since one part cannot be compared with the opposite side, as is the case with extremities. A method of grading in percentages is given in the above table, but any method of gradation is valuable which gives the surgeon some idea of proportionate strengths at the beginning, during, and at the end of a period of training. The information helps him in making prescriptions for continued training, especially in regard to gait training, and in deciding whether or not to do a fascial transplant operation to prevent the overaction and alternate contracture of a portion of the abdominal wall musculature.[2] The charting also indicates the advisability of the use of the shoulder harness,[3] which prevents dragging down, and further stretching of the abdominal group by the weight of big braces on weakened legs.

The following movements are successfully used to provoke action in various muscles to aid in demonstrating imbalanced action:

1. Head raising from supine position, with and without resistance, to actuate recti abdominalis. No movement of umbilicus represents paralysis or paresis of both upper and lower sections, with the tendency for the rib cage to rise and pull away from symphisis; palpation is offered no resistance. With definite palpable resistance, both above and below, no weakness is evident. Care, however, should be used in palpating to feel both sides at the same time with thumb and fingers outspread, because there may often be a unilateral involvement without umbilical excursion up or down.

2. Leg raising, with or without assistance, produces similar actuation of recti, but with addition of lower obliques. Umbilicus will move downward and outward toward that side in which movement of the oblique acts more strongly with viable lower recti; otherwise, the pelvis will tend to twist to a point of fixation, and the umbilicus may pull in an opposite direction, depending on which sector has the stronger group.

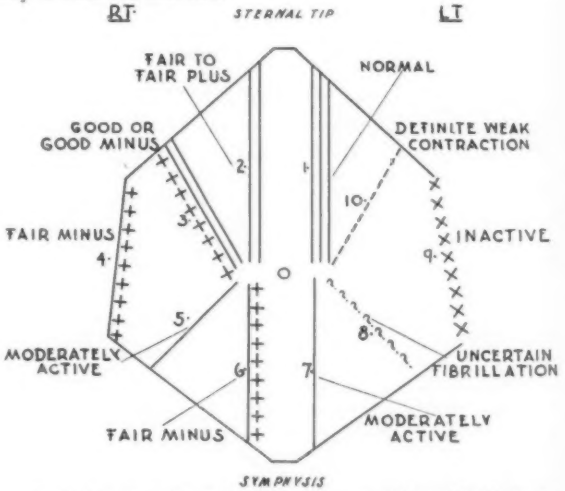
3. Attempts at rolling over will show a lagging of pelvic movement in relation to thorax, as well as a similar movement of umbilicus, or none at all, if paralysis is total.

4. Grasping leg with one hand, pull down, and have patient elevate the corresponding side of pelvis to pull against you. With your free hand palpate the loin muscles. Action of quadratus lumborum behind median axillary line and margin of external oblique in front of it can be felt and graded in comparison with opposite side. Test a second time, and palpate far back to feel action of erector spinae in lumbar area.

5. Leaning over the patient, grasp his extended arm, directed toward the mid line, and resist his forward upward thrust. This actuates serratus magnus, whose insertion pulls on the rib margin of the same side. The stabilization of the rib margin is obtained by the action of the obliques. The umbilical sign will be evident if either half of rectus, or the upper oblique of the same side, or the lower of the opposite side is involved; in the presence of a strong serratus and intact intercostals, the rib cage on that side will flare and raise.

Nothing evinces the presence of paralytic imbalances in the abdominal wall groups more than the action of the trunk twisting muscle groups, in these tests. Their kinesiological importance in all types of spinal and pelvic deformities and displacements will be appreciated if they are used over a period of time, and are thoughtfully analyzed. Because of the greater variety of positions which can be assumed in the water, these trunk muscle imbalances are more evident to the attentive technician when studied in that medium.[4]

The accompanying Figure illustrates graphically the way a chart is marked.



1. *Upper Left Rectus Abdominis.* 2. *Upper Right Rectus Abdominis.* 3. *Upper Right Oblique.* 4. *Right Quadratus Lumborum.* 5. *Lower Right Oblique.* 6. *Lower Right Rectus Abdominis.* 7. *Lower Left Rectus Abdominis.* 8. *Lower Left Oblique.* 9. *Left Quadratus Lumborum.* 10. *Upper Left Oblique.*

1. By C. L. Lowman, M. D., published in New England Journal of Medicine, Vol. 205, Pages 1187-88, December 17, 1931.
2. Relation of Abdominal Muscles to Paralytic Scoliosis, by C. L. Lowman, M. D., published in Journal of Bone and Joint Surgery, 1935.
3. Lowman Shoulder Harness for Use in Double Leg Paralysis, read at Philadelphia Meeting of American Orthopaedic Association, June, 1935.
4. Importance of Trunk Muscles as Evidenced in Pool Work, by C. L. Lowman, M. D., published in Physical Therapy Review, July, 1935.

Physical Therapy in the Mental Hospital

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Mental patients are seriously struggling to walk a path of normal activity, but they are handicapped and lamed. Their peculiarities of behavior are the pathetic and very serious attempts to right themselves in spite of their handicaps. One might speak of this field as one of mental and emotional orthopedics. Physical therapy in the mental hospital may seem to you like carving cherry stones, but it is in reality, or should be, a very serious business applied to an important group of your fellow beings. Many of us are not qualitatively very different from patients in a mental hospital. The difference is largely one of degree.

Physical therapy has been carried on for a very long time in hospitals for mental disorders and probably a good deal of basic importance has already been worked out. An ideal panel discussion would take this basic work as granted and would consider the results of new efforts with the hope of adding something important to what we already have. I hope that I am not at all disparaging if I assume that we do not all share a community of understanding of this subject, for while physical therapy has for many decades been carried on in mental hospitals, it apparently has not been carried on very critically. Exercise, massage, baths, packs, recreational activities and other types of procedures have been a long time in use, but it would seem that there has been little recent progress in the precision of their use. Occupational therapy has had a good deal of attention—perhaps more fifteen years ago than now. It, too, seems to have struck a dead level and for further progress needs careful critical attention. It would seem that we need not so much new techniques as we do an awakened interest, a better understanding and more precision in the application of what we now have.

Among the fairly well settled applications of physical therapy are those used in the cases of hyperdynamic and hypodynamic patients. For the hyperdynamic cases the soothing effects of the continuous flow bath and the various sorts of packs are now regularly employed. For the hypodynamic patients, of whom the depressions make up a large group, stimulating hydrotherapeutic treatments, radiation, salt rubs, massage are also regularly in use in all well ordered hospitals. The application of these physical therapeutic measures, though universally employed, is still very empirical. A great deal of work is needed to bring out the more precise physiological effects of these measures and the physical therapists would perform a very great service if they would be aggressive in these studies.

In the hyperdynamic and hypodynamic cases the problem is one of influencing the so-called drive. The hyperdynamic cases mobilize their energies too readily; the hypodynamic cases have difficulty in mobilizing energy. It is astonishing how generally applicable and fruitful this conception of modification of drive is. Aside from the hyperdynamic and hypodynamic cases, there is a large group of patients who may have energy available, and not in too great amount, but who fail to summon or make use of their energy. Among these are patients who in other respects may be very unlike. These patients as a rule have, for one or another reason, never cultivated the sensory satisfaction of muscular effort. Some of them may have deficiency of coordination or unfortunate inhibition. The problem of educating them to a satisfaction in effort is a very nice one and requires much study of the individual case. The sense of security and self confidence which successful effort gives these patients is in many instances most surprising.

In the group of patients who fail to make an effort to mobilize their energies is that large division of individuals in every mental hospital who are absorbed in subjective activities, largely phantasies and day-dreaming. Once the malignant narcotic effect of phantasy formation has firmly gripped a patient, it is very difficult to get him into activity from which he gains satisfaction strong enough to compete with the inebriating effect of his phantasies. Some patients, however, may be greatly benefited and a very great many may have the level of their behavior considerably raised by carefully applied physical therapy combined with other psychiatric measures. In those cases which are not yet so fully under the spell of phantasy, it would seem that physical therapy with other psychiatric treatment might accomplish very much. In particularly these latter cases, the ingenuity of the therapist is of paramount importance. The careful, judicious exposure of such a patient to situations which almost reflexly call out activity such as, in the simplest case, self protection by catching a medicine ball, often furnishes a start which can then cautiously be built up, extended, broadened out into a more general spontaneous activity and so eventually secure him a satisfaction in group activities with their important socializing effect. The advantage such success gains for the psychiatrist, who is also treating the patient, can hardly be overestimated.

In addition to the overactive and underactive patients and those who fail to summon their energies, there is also the large group of those who misdirect their drive. These patients show a wide variety of manifestations. Among them are peculiarities of posture, gesture and gait. Also, one sees other results of tension such as restlessness, fidgetyness, peculiarities of speech and facial expression. On examination these manifestations are not infrequently found to express, perhaps somewhat symbolically, emotional and mental attitudes which are significant in the mental state of the patient. The physical therapist is here again in position to assist the psychiatrist by treating the patient for these unfortunate drive outlets.

There are many other manifestations of misdirected drive, among which are expressions of irritability, of fault finding, of panic and fearfulness, of offensive and defensive contentiousness, of aggressive self assertion and self depreciation. Such behavior not infrequently, after the manner of a vicious circle, maintains or intensifies attitudes of mind and feeling which stand in the way of successful psychotherapy. Here is a very great opportunity for the physical therapist who recognizes the part which the aberrant drive plays and which may perhaps lend itself to physical therapeutic treatment. In the treatment of such patients the physical therapist will have need of all his resources for patience and observational study.

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The right thing said or done—and it may be a very minor thing—may be a turning point. The physical therapist must know when, judiciously, to leave a patient alone and when, effectively, to show a friendly tolerance or stimulation. The experienced worker will often plan a situation in which the patient may experience success or learn a needed lesson.

A word should be said about the preservation of the patient's drive. He should never be allowed to reach a point of uncompensated discouragement. It is often best to stop an exercise skillfully before the height of satisfaction is attained. In the case of children and adolescents, special precaution should be taken to prevent the recurrence of anything which will condition the patient against pleasure in activity. He should not attempt that which is too hard for him, nor be placed in competition against discouraging odds.

In physical therapy in a mental hospital the physical therapists as a group should stand solidly for one point. They should insist that the psychiatrist take them into his confidence to such an extent that the latter appreciate, as far as it is understood, the nature of the patient's difficulty and his personality. The psychiatrist is very apt to take too much for granted, with the result that the physical therapist works too much in the dark and without precisions beyond that which his own judgment and observation may indicate. This may suffice in some cases, but in most instances even all the available information about the patient leaves much to be desired. The psychiatrist should furnish the physical therapist with as clear and concise a statement of the problem as a study of the problem at that time permits, and he should add to it as the study advances.

On his part, the physical therapist should remain continuously alert to search for means by which he may estimate and check up the value of his activities. He should seek always for greater precision in his work, yet at the same time he should remember that routine method is a very dangerous support. It is true, as I have said, that already certain basic practices are firmly established, but these should be applied with a flexibility suitable to the case in hand. Every therapist leans on these basic principles of practice, but at the same time he should be reaching out intuitively and empirically for an extension of his armamentarium with the hope of reducing promising measures to precise evaluation. The physical therapist should observe and practice noting down his observations in such a form as to build up a body of data from which he may draw inferences and eventually conclusions.

I should be pleased if I could leave with you the working impression that there are not two entirely separate and independent factors—a mental and a physical—operative in mental patients. That which we call mental is merely a subtle refinement of what is called physical. If you dangle before an animal food which is difficult for him to get at, you will create in him a series of efforts to get the food. This might be called a physical stimulus to action. If again you in yourselves hold before your imagination desired objects which are not unattainable, you will equally with the animal, in all probability, make effort to get what you want. In your case you will have used a refinement of method in stimulating yourselves to action but essentially the same processes are by this method thrown into action as in the case of the animal. There is therefore no reason why the physical therapist should be overawed by the so-called mental aspects of his patients.

Nevertheless it is probable that no one should take a leading part in physical therapy who has not had adequate training, scientific and cultural, or its equivalent. This is a very delicate and a very flexible matter, but should not be neglected.

The physical therapist should understand a point with which the psychiatrist by experience has become very well aware. This is that treatment of patients cannot be made impersonal. It should be understood that the patient intuitively sizes up the therapist and is apt to be quite as observant of him as the therapist is of the patient. The patient will be influenced by the therapist when the latter little realizes it. The physical therapist, therefore, over and above his mastery of his technique and his scientific and cultural equipment, must also have a skill in approach to patients and a delicacy in the application of his techniques which imply an appreciation of the subtle emotional reaction of patients and a self mastery which keeps him alert and in good self command. At the same time it is quite as important not to be too personal in treatment.

While physical therapy is a very seriously important matter in the treatment of patients in mental hospitals, I trust you will not think that I overestimate it. The treatment of a patient in any department of medicine is a very serious matter. The treatment of a patient who has fallen so ill that his residence in a mental hospital is necessary, is often in as critical a condition as he would be with an appendicitis, heart disease, tuberculosis, or arthritis. There are other interests in life in a mental hospital than physical therapy, but in the mental hospital this phase of treatment should be raised to a higher and more useful level than that at which it now stands. The elevation of this practice must in a large measure lie with you. You will continue to get less consideration than you should have, unless you study to improve your understanding of the problems of the mental patients, refine your application of your techniques, and stand together in demanding full cooperation of the psychiatrist.

Some Mental and Physical Problems of Muscle Training

Ruth Aust

In most articles on the technique of muscle training, emphasis has been laid on the necessity for the technician's having an exact knowledge of kinesiology, anatomy, and physiological principles. We should like to emphasize the specific application of these sciences and in addition, the greater role that psychology plays, especially in the handling of difficult or unresponsive patients.

We can review quickly the various objectives of physical therapy: namely; 1. the training of muscles and the maintenance of proper muscular balance for the prevention of deformity and the maintenance of posture; 2. the avoidance of undesirable substitutions and teaching of desirable ones; 3. the improvement of muscular strength; 4. the prevention of atrophy and betterment of circulation and nutrition; 5. the maintenance of joint movement; 6. the helping of the patient to readjust himself to his situation.

Since so many institutions have both treatment rooms and pool, the specific advantages of each are becoming more obvious, we can review the anatomical and physiological program briefly. Utmost care must be taken, in either pool or treatment room, to brace the muscles, guard against stretching, and control the overactive muscles. Inequality of muscular force has the same deforming effect in either treatment room or pool. Each case must be carefully analyzed by the physical therapist before a program of treatment is adopted. The need for testing all muscles carefully before treatment is instituted, and retesting at intervals has been emphasized frequently. From all scientific data available the physical therapist makes decisions and steers the course to suit the needs of her patient. Each fact forms the basis for solving some problem or difficulty. The control of fine muscles, as in the training of the muscles of feet and hands, requiring the patient to watch and concentrate for long intervals probably is accomplished more satisfactorily in the treatment room, as the environment is free from distracting elements. Also, for muscles that can overcome gravity but not normal resistance, the treatment room is probably preferable.

The use of water as a medium for muscle training with its lack of gravity pull and consequent non-fixed fulcrum base has given us a new conception of muscular action. The entire body or any of its parts may move in any plane. Gravity load is so reduced that while the patient stands neck deep in water, there is almost no weight on the feet. The ability to graduate the amount of resistance is a great therapeutic advantage which cannot be gained with the use of the treatment table. For example, in moving a leg parallel to the surface of the water, the only resistance is the viscosity of water. Bracing, however, must be carried on in the pool as carefully as on the table. Wooden splints for use on the surface, wire splints for use in walking, special braces for the back, and abdominal aprons may be used as indicated.

The psychological advantages of training in the water are worthy of real consideration. The new patient whose muscles are still sensitive enjoys the sedative relief of the warm water. The helpless patient rejoices in his ability to move and play. The child sustains his self respect. A boy eight years of age was teased by others because he was paralyzed and could not fight. Johnny, however, bragged that he could beat any of them staying on the bottom of the tank. The adolescent can have his desire for group activity and competition can be satisfied, and at the same time the required therapeutic movement can be achieved. Tandem movements of two or more in chain formation call for skill corresponding to that needed in football and basketball.

Dealing with the psychological problems of the paralyzed patient is one of the most serious difficulties which confronts the physical therapist. To an adolescent just beginning to realize his ambitions, an attack of anterior poliomyelitis usually results in the drastic disillusionment of the patient and a distorted outlook. This danger of warping character and distorting personality demands as much or more consideration than does the restoration to physical normality. Keeping the patient in the frame of mind necessary to localize muscular contraction, even when there is no immediate sensory satisfaction as a result, requires psychology of the highest type. In order to maintain such a state of readiness, the patient should experience some satisfaction in executing the effort of movement. For example, after six months treatment, one patient beginning his fourth year of convalescence, improved the power of a feeble deltoid muscle to the point at which he was able to raise the arm against gravity. Muscle training did not interest him. His one desire was to have some sport in which to participate. He had been an ardent tennis player. Work was started in the pool, with the patient's arm supported by a rubber float. He was given a light badminton racket and permitted to bat balls. Thus his arm muscles were reeducated to such an extent that six months later this patient was able to execute a forehand drive on the tennis court. The result is a decided improvement in his morale as well as confidence in his physical ability.

The *will* to recover is necessary to attain the maximum of improvement. If the parents grieve unduly over his condition, the adolescent cannot become adjusted, or if the muscles remain flail after a long period of training one cannot expect a maximum of effort. The will to recover must be stimulated by adjusting the environment, by producing results that satisfy and by employing procedures pleasing to the patient. The emotional control required compares to that of the Hindu fakir.

The laws of learning, as stated by Gates of Columbia form the basis of the psychological principles employed in physical therapy.

1. "The Principle of Readiness: The more fully an individual is in readiness to act in a certain way, the more satisfying it will be for him to act in that way, and the more annoying it will be not to act in that way."[1] The patient is anxious usually to walk, to step upstairs and to get out of and into a chair. If he is allowed to

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fulfill his ambitions in the water he cooperates better during his muscle training and also appreciates the purpose of localized effort. One child refused to try to concentrate. After the leg and pelvis were braced and she was allowed to walk in deep water long before it seemed advisable to even stand on the floor, concentration and effort greatly improved.

2. The Law of Effect: "Individuals tend to repeat those reactions which on the whole are satisfying, whereas they tend to avoid" and therefore fail to repeat those reactions which on the whole are annoying.[2] We all know that a patient with a flail limb gradually loses interest. Often a muscle too feeble to move will fibrillate if the operator's fingers indicate the position and press enough to register the contraction of the muscle fibers against them when contracting. In this, the patient experiences introceptive satisfaction and will tend to repeat the effort.

3. The Law of Frequency: "Other things being equal, the more frequently a connection has been exercised, the stronger the connection."[3] Muscles, such as the quadratus lumborum, which fixes the pelvis for movement of the thigh in different directions, may become overactive because of the frequency of use. Overactivity of the peroneal muscles also calls for a diminishing of the function of fixation. Otherwise, these muscles will be used for every movement of the foot except inversion.

Consideration of these laws of learning provokes a review of the gross nervous structure which we constantly attempt to modify. The lower motor neuron is the one affected by anterior poliomyelitis.

1. The simplest reflex action is the function of a muscle in maintaining posture and fixing the joint. This is brought about by the excitation of deep sensory nerves carrying their messages to the cord, and stimulating the cell of the lower motor neuron. Sometimes, if the patient lacks the emotional stability to concentrate on contraction of the muscles, he can be stimulated by this route. When a patient stands (in water if necessary) and starts to lean backward the abdominal, quadriceps, and tibialis anterior muscles are reflexly contracted. It offers a very desirable means of beginning muscle training for a patient who is lacking in kinetic sense.

2. The conditioned reflex is the functioning of a group of motor cells as a motor pattern. The most natural way to stimulate a muscle into voluntary action is by performing a fundamental coordination such as walking, using that muscle. One patient who had had intensive ballet technic before the onset of anterior poliomyelitis lacked even a trace of power in the gastrocnemius muscle. A victrola record of the same music which the ballet instructor had used for foot exercises was played. When the foot was moved passively as in the dance routine, the heel cord tensed. Very feeble quadriceps muscles act amazingly better if a boy can attempt to kick a football on the bottom of the pool.

3. Localized contraction of an isolated muscle is the most difficult control to achieve, as such a neuromotor path is seldom developed naturally. Even with a normal foot, one has great difficulty in tensing the tibialis anticus only. This very difficult new control, however, is what the paralyzed patient must learn. After the patient learns the isolated control, he must adjust that control into a new motor pattern or a modified old one. A patient, confined to bed, chair, or crutches and braces loses his ability to adjust himself to emergencies unless these motor patterns have been exercised probably necessarily in the pool.

Several factors call for special consideration:

1. Some muscles are so interrelated in function that they not only demand specific training but must also be trained in a motor pattern with each other, that is, "trick" coordinations. The internal hamstring muscles may be taught adduction and then must assume responsibility in the performance of the leg movements. If the external rotator muscles of the humerus are weak, the latissimus dorsi muscle may be taught to substitute for them in depressing the head of the humerus in the glenoid fossa during abduction. The simultaneous contraction of the gluteus maximus with the quadriceps might be taught profitably.

2. The intrinsic muscles may have been brought to the peak of their ability but may be ineffective because of the lack of the extrinsic control. Coordinative motion or motor patterns may be used to train a fixator. It is not unusual for a patient who has had poliomyelitis some six or seven years before beginning training to learn to walk for the first time after a few months of muscle training, by using abdominal muscles as fixators. The flexor muscles of the hip are ineffective if the pelvis tips. A program of muscle training must take into account the maintenance of these motor patterns in conjunction with the localized training. Such consideration shows water to be the necessary medium for movement. Of all the muscles of the body the abdominal muscles are the most difficult to train without the medium of water because their action is largely extrinsic. In the pool, whenever possible, use bandages rather than stiff, long leg-braces to prevent toe drop, genu recurvatum, gluteus medius or gluteus maximus limp in order to continue the correct interrelationship of muscular performance with power in the fundamental patterns.

3. The effort to stimulate every fiber of every muscle must be made before the neuro-motor path can be completed. The advantage of work in water lies in the opportunity for calling every fiber into play in the way it originally functioned. Various muscles and fibers of muscles seem to have one or more of the following characteristics:

a. Maintenance of its own length. There may be reflex contraction without the performance of movement, as in tonus or in resistance to a load. Some muscles tend to have this as a primary function. This usually develops bulk or thickness of the belly of the muscle. The gluteus medius serves as an example of this characteristic. In this case the origin is drawn toward the insertion and the main function of the muscle is to maintain its length. In this connection, the question arises whether muscle training should first teach maintenance of length to the muscle and then teach contraction.

b. Another characteristic is shortening or contracting. This is commonly seen in the tibialis anticus. Shortening develops skill, speed, timing and coordination. Strength seems to develop more slowly by this route.

c. The third characteristic is the ability to release a load gradually. The muscle, besides pulling the insertion toward the origin, may also pull the origin toward the insertion (gluteus maximus) or approximate both (rectus abdominus).

All types of circumducting movements from either the horizontal or the vertical axis, are possible because of the variety of ways of working a muscle; by using a variety of nerve pathways, nervous fatigue may be avoided until the muscle's maximum work has been done.

Muscular fatigue is obviously brought about by rapid contraction and relaxation of the muscles, or work against too great a load. In muscle training we are de-

pendent upon concentration. Concentration fails more rapidly than muscle fatigue occurs. If the state of readiness is changed or other motor patterns are used, the muscle will continue to work very strongly. For example, in the patient who has contracted the small muscles of the hand a few times, performance will decrease. If, however, he is given a ball and allowed to play with another person, his whole strength immediately increases. In contrast is the patient who has exercised a muscle such as the biceps, against resistance. The strength rises, becomes stationary, then decreases. This muscle has been worked to its peak and will diminish steadily under any further effort. A more rare example is that of the patient who is mentally exhausted following treatment. After resting half an hour, he recovers mentally. The physical strength has at no time gone to a lower level in performance.

If we could reach the maximum load of the muscle by using every nerve channel to that muscle, we probably should be able to increase the strength of that muscle much more rapidly.

Summary:

1. The environment and the psychological adjustment of the patient must be corrected before the maximum results of muscle training can be attained.

2. Psychological laws of learning as stated by Gates have been of assistance in solving some of the problems met with in the case of patients.

3. Muscles are more easily activated by the postural reflex and the conditioned reflex pathway than by direct isolated control.

4. Muscular control is often obtained more rapidly and with satisfaction if natural function rather than individual contraction is required.

5. The treatment room and the treatment pool offer different advantages. The use of the room is more desirable for gravity load and fine concentrated movement. The pool permits training of fixators of the joints, postural and conditioned reflex motor performances, and dimensional movements.

6. Recognition of the difference between mental and physical fatigue is very important in muscle training in order to bring results up to maximum.

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1. Gates: *Psychology for Students of Education*, pg. 282.
(Arthur I. Gates, Professor of Education, Teachers College, Columbia University.)
(Psych. for Students of Ed., revised edition—New York—The Macmillan Company, 1931.)
2. Gates, pg. 271.
3. Gates, pg. 255.

Rational Physical Therapy in Mental Hospitals

Harry E. Lawson

The main function of a general hospital is to bring about a healthy functioning of the organs of an individual. The main function of a mental hospital—and the aim—is to bring about the healthy functioning of an individual in a group or society. To bring about this healthy functioning, medication of the general hospital is not the predominant feature, but therapies of rest, diet, physical and occupational therapy, experienced and educated nursing service, and consultations with experienced psychiatrists, are the essentials. A close integration of all departments with the doctor is vital to the success of our main function of returning the individual to society. Each phase of the work in physical therapy should be evaluated and linked one to the other. Avoiding or ignoring such a set-up encourages inefficiency. An educated, understanding group of workers and an integrated system are necessary. On such a basis we may justify the existence of our various departments.

Our problem centers around the integration of the individual in the group—an *inter-person relationship*, a relationship not unlike our everyday contacts in society. Through the recreational program we are able to satisfy the physiological necessities, so important in the lives of mentally ill patients, the psychological aspects, vital in individual and social relationships. and the sociological phase so necessary for an integrated personality. Through the recreational program there is more of an opportunity of developing inter-person relationships, that is; how is an individual to fit, with whom does he enjoy playing, from whom does he like to stay away, who slows him up, and who sets the spark for spontaneous play? The recreational program is not unlike a project in the industrial world involving more than one individual—working alone on a project is *work* and the individual is susceptible to many difficulties. But place him on a project involving several individuals and his morale is immediately elevated through psychological factors in the social relationship. There is opportunity for and development of inter-person relationships.

I am particularly interested in rational physical therapy as it relates to the recreational program in mental hospitals and how it may be used as a means of assisting patients to live out their aggressions. Here aggressions is used in an entirely wholesome sense. It is, that reservoir of inner drives which breaks out in emotional upsets and which when directed into satisfying game situations permit more of an opportunity for individuals to live balanced lives. We may think of it as an outgoing impulse like sucking or biting.

Situations which give rise to these aggressive tendencies are a frustration of some kind. For example, I strike my hand against yours and you resist this aggression—I am frustrated and resent this resistance but control my emotions. There is not only this damming up of resentment but there is the "damn it" attitude of frustration. It is this that we must satisfy in some way.

Another illustration of what is meant by aggression: I may have a fight with my wife and my impulse is to cuss her, snap at her, or possibly strike her. But I hold myself in check, outwardly appearing calm, or in other words, repress the aggression. But now what do I do? I may go out of the door and if the dog or cat is around,

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Presented at the convention in Atlantic City, June, 1935.

take it out on them by kicking, or I may show ill feeling toward the bus driver or be impatient or irritable to the elevator operator. I repressed this aggression toward my wife because I knew that if I had struck her I would have had a tremendous feeling of guilt but I take it out on the bus driver because the sense of guilt is not so great.

This matter of aggressiveness is amplified and often repeated in our daily newspapers. Such terms as we read in the headlines of the sporting pages, Tigers maul the Bears, or John Doe beats up Joe Doe. Another indication of the aggressiveness element. This, of course, may be known but we are merely emphasizing it. So, we see all play is out to satisfy permanent aggressive drives, even though in sporting terminology.

Aggression is the most important element in many typical forms of recreational play, ball, football, volleyball, tennis, soccer, and it may be doubted whether it is altogether absent from any. We need rather to distinguish "playful" aggression in play, from other forms of its activity. This difference lies in the complete absence, in play, of aggressive hate or rage; or in the way in which hate is psychically bound by pleasure. There can be no "play" attitude while there is overwhelming impatience, hate or anger.

Some individuals just in watching games, that is, the gallery sitters, live out their aggressions and secure their satisfaction vicariously, taking the place of another person (serving as a substitute), through their identification with the players.

We, as leaders, have a very powerful force at our disposal, which if used to a purpose, may prove of great value to us as teachers, to doctors in charge of cases, and more important, in the assistance and well-being of patients. I refer here to play—spontaneous exercise of a function, participating merely for enjoyment, relaxation and fun in it. Freud in his exhaustive studies has provided us with a most important, yet quite neglected hint: "Play links the wish, life, and psychic realty, with external reality." That part of our knowledge of the external world which is stable is built upon the basis of pleasure and play, not of pain and anxiety. To take advantage of this experience and background not only is good common sense but in tune with a very natural fundamental. There is a very natural relationship between play and the desired social responses, and through play we have the most effective way of getting close to patients.

CASE ONE

This patient was admitted to the clinic in the winter of 1933, with a complaint that he was unable to control his irritability. At the time of his admission he was twenty years old, unmarried, and a student.

His outbursts of irritability were directed at his parents. He was the youngest of three and the recipient of much solicitude. The parents were constantly apprehensive that he would over-exert himself in study and social activity. As a consequence, there was much friction with frequent outbursts of anger. He reacted to these episodes with strong guilt feelings and was so worried by his lack of control that he was slipping back in his school work.

He had always been an aggressive boy and his frequent fights with his mates were a matter of much concern to his parents. Attempts to discipline him in childhood were met by an increasing resentment. He resented not only the attempt on his parents part to curb his independence, but also their solicitude about possible danger to him. These same reactions were repeating themselves in the problem he presented at the time of admission.

The boy had some insight into his mother's efforts to keep him under her wing. A few psychotherapeutic interviews with the psychiatrist served to give him more objectivity about this. He was put on a program of boxing, wrestling, and swimming. The results were striking, and as his tension lessened, the outbursts of irritability disappeared, and he became a leader in his class work. The good results have persisted.

Apparently a certain amount of physical tension had been lessened. He was permitted to express in a modified fashion aggressive drives that had been under inhibition only to burst out in a socially inacceptable fashion without guilt. Also, the mere fact that he was given permission to express aggression in this fashion (formerly frowned on by his parents) was a source of satisfaction and tended to cut the amount of resentment in itself. Finally, the exercise produced a balanced program for him because he had been operating almost exclusively in the intellectual fields. He has returned to usefulness, now doing well in medical school.

END OF CASE

Through athletics or sports, aggressions may be sublimated into satisfying situations and in athletics or sports we have a natural means of expressing these instinctive aggressive drives through the muscular system —the very earliest natural means of expressing aggressions.

A baby before it can talk gets rid of aggressiveness through the musculature by kicking, reaching, rolling, crying, sucking, etc.; and children when aroused to a pitch of anger, express their aggressive urge through the muscular system, by stamping, running, beating of hands against the head, and through biting. Each individual presented to us for admittance into some form of therapy, experiences some difficulty which we may correct or adjust by developing a situation through a recreational program which will satisfy his aggressive tendencies. With such a natural means through the musculature, the individual may rid himself of his aggressiveness in situations in which there is absence of guilt. Then, too, in directed satisfying play we may develop attitudes—not so much what one does in play as how he feels about what he does. This is what makes the difference between play and drudgery. True mental and physical happiness lies in automatic functioning that is unconscious of fear. Play attitudes may be recognized as a mirror or reflexion of a patient's reactions in a controlled environment not unlike that which this patient experienced on the outside. A picture of these presented to the psychiatrist in charge enables him to point out to the patient his experienced difficulties and wherein adjustments may be made.

CASE TWO

Patient admitted to clinic in winter of 1934 with complaint that because of his anxiety state he was fearful of maiming others or himself.

He was thirty-eight, twice married, first marriage happy. Two sons by first marriage. Second not so happy—present wife cold, domineering and works her resentment on the sons by the first wife.

Patient was once a great athlete but since the family came he gave up recreational activity.

He was a very intense worker—always wanted to be busy and did keep busy.

Cold, domineering wife submerged this man, was

cold to him sexually to the point that he believed she was not true to him.

He now turned his aggressions to a great desire to maim others or cut out his own genitals. He developed intense anxiety states, very fearful, and a strong sense of guilt. During his first few days in the clinic he would not get out of bed because he was so fearful—he said he could not get close enough to the wall.

Through a vigorous play program, squash, soccer, volley-ball, he was able to control these aggressions and sublimate them in activities which left no fears or anxieties—he had a healthy outlet where tensions were lessened and these aggressive drives were satisfied through keen, wholesome, competition.

A play program along with effecting happy home conditions allowed this man to readjust his life so that now he is happy again in his work and in his home.

Through his play attitudes in the gymnasium we were able to appreciate this man's drive on the outside, his consideration of others, his humor, and his reactions of changing situations. We were able to direct his drives into satisfying game conditions and ease his physical tension as well as state of anxiety.

END OF CASE

Different individuals have different ways of answering this aggressive urge and aggressions affect individuals differently.

There are those who experience a maladjustment because of some inhibited drive—a man may hesitate to direct an employee or business associate because of the resultant effect upon the employee or business associate. As a consequence, this individual builds up fears and anxiety. He fears to go on because of retaliation.

Then there are those who, because of misdirected drives, such as restlessness, pacing back and forth, agitation, sarcasm, irritability, lack of assurance, unworthiness, suffer because they are unable to make adjustments in a social environment.

Others because of diminished energy need special attention and very often the mere tossing of a ball may bring about a reaction (even though for self protection), sufficient to start an individual on the road to recovery.

Finally, there are individuals with an overabundance of energy to be treated so that this excess energy may have an outlet, but directed into constructive satisfying ways.

Because of this it is quite important that the recreational leader have a fairly good picture of the patient's background, a sympathetic understanding, a flexible system of getting at the same thing through many channels, and a willingness to try out different ways of discovering a solution to a patient's difficulty. This latter point brings up the importance of frequent private consultations with the doctors on the staff regarding specific treatment of patients, changes, suggestions, etc.—an interchange of ideas following daily observations and practices.

Content disclosed in recreational situations is very significant, because by means of it we may show in the main a patient's reactions to interpersonal situations. How does he make an adjustment? Whom does he like? Does he show any dislikes? Does he begin to sense that feeling of living outside oneself? What do patients talk about? Does he show any desire for companionship or does he crawl farther into his shell,—does he withdraw?

We, as therapists, are in a very strategic position to give doctors important information of patient's attitude in games, but what is more, we have unlimited possibilities of evaluating our work and carrying on an increasing amount of clinical observation.

Content, pertaining to relationships with people, is very important in our work and no situation should be overlooked which might help us in affecting an adjustment for a patient. In no other form of therapy in mental hospitals do we have an opportunity to observe patients under conditions so liberal or free from restraint. Operating in an informal play atmosphere with satisfying play situations, the patient very early develops that very important buoyant type of enjoyment when he feels free, which encourages wholesome interpersonal relationships. After all, play is not a side issue of life reserved for children—the joy of doing goes through life and we miss a very fundamental as well as powerful force if we do not utilize it and direct it in our therapies.

Life is a game and a man's whole attitude toward life may be reflected in a game. How does he attack, and how does he meet attack? If he is rebuffed once will he come back or does he become discouraged? Is he passive or submissive? Does he like to team with a weak player or strong player? As he plays a game, so does he play the game of life—it is a reflexion of his attack.

A very important point not to be overlooked is the vital part the therapist plays in the lives of mental patients—the therapist is a part of the patient and no move however insignificant goes unnoticed by the patient. This was brought home more clearly to me recently by a patient upon whom we had been concentrating and trying every possible means to aid him out of his difficulties. We finally were rewarded in bringing him to a point where he participated with the convalescent men of the active group. He was beginning to show and be aware of his power and showed a tendency to make some advances. He had completed a piece of work in the metal shop and secured considerable satisfaction upon the completion of the work. He offered this piece of work to a young lady who refused it, in a graceful manner, but the refusal was a frustration to the patient and he immediately went into a slump. A full week has elapsed and the patient is just beginning to react to very elemental types of activity. Anything we say or do may play a very important part in a patient's recovery.

The question may quite naturally arise, "Well, what method do you use in directing patients into various forms of physical activity?" No cut and dried method can be used in cases as we experience them because no two individuals are the same nor are they apt to respond in the same desirable manner. To answer this I would say that method is dependent upon the objective intuition of the leader gained through experience in handling cases.

A patient, in this atmosphere, of feeling free, is toned up, is stimulated and in turn creates an infectious tonic to others present. It is truly a tonic. But what does it do for us? We have an excellent opportunity to evaluate our work because through it all we make observations and mental notes for our records. This note taking must of necessity be unobtrusive and our play with the patients must be the full play spirit. But immediately after each group meeting conversations should be recorded, reactions noted, remarks, if any, noted, improvements, as well as setbacks noted—all with the definite purpose of aiding the patient and the doctor, and evaluating our own work. Records of what we

see, do, and hear, play an important part in inferences which in turn may result in conclusions valuable to others in our field. In this note taking we may observe how a patient works with the group, that is, team work; is he group conscious, what sort of contact does he make, is he stronger on offense or is he better on defense? Does he show any development of strategy, does he show initiative, is he resourceful, does he conform to rules of the game, does he show any spontaneity in play? Does he show any tenacity? How does he concentrate and apply himself? Can he shoulder responsibility? There are some people who may be able to win in a group where responsibility of defeat may be spread out or divided by the members of the group, but place these people in a situation where individual responsibility is to be shouldered and they cannot accept it. There is fear of retaliation, such a man is X who bears down up to a point where he is ahead and he fears to win.

I have endeavored to point out: first, the value of a game program in mental hospitals and how it may serve in the sublimation of the intense aggressive drives, experienced by patients; secondly, the evaluation of our work; and thirdly, the significance of carrying on research studies.

The Value of Mental Hospital Experience to the Physical Therapist

Ruth Hobbins Wheeler

In the past few years the field for physical therapy in the care of the mentally ill has grown. Until recently, however, there was comparatively little work done along this line, with the exception of medical hydrology. There is much to learn of the value of the biological effects of the various energies in this field, we know, and we feel that what is being done at the present time may be only a beginning. If this is true, there will be an increasing need for physical therapists interested in this type of work, especially since the time is long past, when there was a feeling that close association with the mental patient would either be depressing or actually dangerous, a feeling that kept many a physical therapist from seeking employment where such patients were cared for.

It seems to me, personally, that the experience to be gained in a mental hospital during even a short period of time would be of great value to any student who is hoping to succeed in her profession. She would develop her tact, her patience, and her personal poise. Her powers of perception and adaptability would be strengthened at the same time that she would be gaining the practice needed to make her a thoroughly qualified physical therapist.

While these patients are mentally ill, they are subject to all the physical disabilities common to the normal individual, the muscular aches and pains, the injuries, deformities, skin conditions, etc. We find even more poor physical health among them because of the fact that in most cases of mental disease poor circulation, poor posture and poorly functioning digestive systems are the rule. There is perhaps little that the physical therapist has to offer for relief or cure of the mental disease directly, but there is much to be done in relieving pain and discomfort, and in helping to build up and maintain a healthy body.

The psychological element in physical therapy is of undoubted value to these patients, especially to those who are on the road to recovery, whose interest in themselves and in the world about them is awakening. The daily change in environment which his visit to cheerful treatment rooms affords him is of distinct benefit. The idea that something is being done for him personally makes its impression. Even if he is so disturbed or in such depression as to seem oblivious to his surroundings, he seldom shows reluctance to make his daily visit for treatment.

The physical therapist caring for these patients is confronted with many problems which she would never meet in the general hospital. For this reason she should not only be thoroughly trained to carry out the technical part of her duties carefully and conscientiously, but should be endowed with a large fund of old fashioned common sense. She must be able to recognize and discount exaggeration of symptoms, and to obtain her information from watching her patient rather than listening to him.

In making his diagnosis of the physical condition in question, the doctor is almost never able to obtain all the information he desires. Either his patient is mentally upset and cannot give it to him, or is negativistic and will not do so. Thus he is turned over to the physical therapist for treatment. Her observations, if intelligently made, can be of immense value. She must know the probable symptoms of the condition, learn to disregard complaints of pain or disturbed sensation which cannot possibly exist. She must watch his use of the uninjured part as well as of the injured, to determine how much of his poor function is due to his disability and how much to a postural defect associated with his psychosis.

For instance, treatment is ordered for a Colles fracture in the case of a patient diagnosed as a dementia precox of the catatonic type. The fracture has been x-rayed, reduced and properly splinted.

The patient presents the picture typical of his mental condition—a pale, expressionless countenance, poor posture, uninjured arm hanging limp by his side, and hand in the "dropped wrist" position. During his entire

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treatment he is entirely passive, but will respond to commands to move his fingers, flex and extend his fingers, etc.

The problem is to determine in mobilizing the joints, just when the point of pain has been reached, since the patient neither speaks nor shows the slightest sign of pain in his facial expression. Even the end result will sometimes be unsatisfactory since, with circulation sluggish, as it is in the catatonic, swelling will persist, and, the "wrist drop" position maintained will make it seem that the extensors are still weak. Since the patient is doing so little to help himself, it is hard to determine whether normal use of the muscles is possible. Every means therefore is used to restore the arm and wrist to normal, and the physical therapist must use the best judgment of which she is capable. The catatonic phase of his psychosis will pass, and she owes him a useful hand to use when he can again take up active duties.

Such patients are so often insensible or indifferent to discomfort that heat applications must be more carefully given than to the normal individual, and careful observation made of the physical signs of a beneficial hyperemia.

The mentally ill are usually very susceptible to suggestion. The physical therapist must not ask "you have felt pain here," or "your fingers are numb when you waken in the morning," as her patient will invariably answer in the affirmative, and add complaints that mean little or nothing. She should use the attitude she would employ with a child, and if she makes suggestions, they should be of a constructive nature.

As the days go by, the worker learns to handle these problems. She learns patience, tactfulness and learns to use all the ingenuity of which she is capable. These qualities are necessary to every physical therapist who expects to succeed in her profession wherever her duties may call her, therefore where could she obtain a better training than in a short period spent in the care of the mentally ill.

Hyperpyrexia in General Paresis

Alice A. Sheahan

In February, 1930, the treatment by diathermy of patients suffering from general paresis was begun at the Worcester State Hospital. The project was under the direction of Dr. Clifton T. Perkins, assistant superintendent of the hospital and instructor in therapeutics at the Boston University School of Medicine. Prior to this time but little work had been done in this field. That which had been performed was largely of an experimental nature, and of insufficient duration to supply conclusive data as to results, technic, and so forth, and reliable information was scarce.

Though medical science has long recognized the fact that fever is evidently one of the chief agencies of defense against invading organisms possessed by the human body, safe and controllable methods of introducing fever into the body as a form of therapy have been at a premium. In the treatment of general paresis, malaria therapy proved to be the most efficacious and most popular form of febrile treatment. Here fever was produced by the inoculation of the patient with malaria plasmodium; the resultant fever seemed to alleviate the disease, and diminish its effect. However, all patients were not susceptible to malaria; immunity was especially prevalent in the colored race, where also there existed a fairly high percentage of general paretics. Other means of producing fever were found to be less effective than malaria; however, from the fact that these other agencies were at all effective, it seemed that the fever itself, and not chemical changes in the body resulting from the introduction of any particular foreign organism was the alleviating factor. Since this was felt so strongly by so many groups working with fever therapy, far-sighted physicians immediately began to be concerned with the possibility of securing the desired degree of fever in a safe, practical manner that would not have the many disadvantages of the malaria treatment.

Diathermy seemed to supply the answer, once the problem of securing equipment that was capable of producing a heavy load over a long operating period had been solved. Satisfactory fever-producing apparatus was forthcoming; the greatest single problem remaining was primarily one of technic, and was that of retaining the generated heat within the body, that is, cutting radiation to an absolute minimum.

This is a sketchy outline of the story behind the inception of the diathermy treatment at Worcester State Hospital. Though other institutions had done some work in this field, the project here was to be, not an experiment, but a permanent part of the hospital routine. Unless, with the passage of time, the treatment proved to be of no value, or it developed that it could not be applied in a practical manner to the type of patient resident in the hospital, there was no question of abandoning the project. We were extremely anxious to find out if diathermy could be used in the treatment of general paresis for the simple reason that the staff of the hospital honestly believed, with many other progressive physicians, that this type of treatment, once it was thoroughly understood and properly applied, would be more efficacious, more positive, more flexible in operation and much more comfortable for the patient than any other known means of combating the disease.

It was immediately evident that the problem of technic was vitally important to the success of the treatment, and that, lacking methods proved satisfactory by long use, the physician and technician would have to work out, by the tedious method of trial and error, a

Worcester State Hospital, Worcester, Mass.
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general technic that would be both effective and practical. This matter of technic was further complicated by the fact that at first it had been decided not to administer drugs to treatment patients, and that patients for diathermy would not be selected with the idea in mind of using only patients from whom some cooperation might be expected; we were to take those paretics resident in the hospital, no matter what their mental status, and many of the known paretics were classified as disturbed.

Much of the success of the treatment, I feel sure, has been due to the excellent pre-treatment schedule worked out by Dr. Perkins and carried out by the various departments of the hospital, under his direction.

These tests, listed below, are begun when the patient is transferred from the psychiatric to the medical service, five or six days previous to the diathermy treatment and repeated following the series.

1. Complete physical examination.
2. Blood tests (Wassermann, Hinton and Kahn),
3. Complete blood counts, Schilling index, and chemistry.
4. Basal metabolism (if patient is cooperative).
5. Psychometric examination.
6. Psychiatric case note (by a staff psychiatrist after interview c pt.).
7. Special diet.
8. Twenty-four hour amount of urine for nitrogen partition.
9. Patient's weight to be taken before and after each treatment.
10. S.S. enema to be given before each treatment.
11. A course consisting of ten treatments, given daily, with the exception of Saturday and Sunday. The laboratory work during treatment is as follows:

1. Blood counts at the start, 102° and 105° of the fifth and tenth treatment.
2. Blood chemistry at 105° on the first and last treatment.

The mental and physical examinations completed, and the data assembled for study, the patient is ready for treatment.

Although we have changed our electrodes during the past year, the wrapping and care of the patient under diathermy is essentially the same. On reaching the department, the patient is stripped and placed on the treatment table, where phototherapy is applied, ten minutes to the chest and ten minutes to the back. This did not, as we first believed, tend to shorten the time of diathermy, but served in causing the skin to become moist, making better electrode contact. This has been discontinued with the new electrodes.

The treatment bed, is prepared with two heavy blankets and a two-inch roll of cellucotton, placed crosswise on the bed, in order to reach from shoulder to hips. The patient is then placed upon this and the blood pressure is taken and recorded on the chart. The electrodes are applied, a rectal thermometer is inserted, and six blankets are placed over the patient, which are wrapped about him very much in the manner of a hydrotherapy pack. This method of wrapping serves as a mild form of restraint and helps to keep the electrodes in place. The current is then turned on at approximately 1,000 M. A., where it remains for fifteen minutes, after which it is gradually worked up to the maximum, 3,600 A. M. during the next half hour. Temperature, pulse, and respirations are taken and recorded every fifteen minutes until the desired temperature of 105° is reached. This is also carried out on the ward, after the patient has been returned, until his temperature is normal. During the treatment the patient is allowed to drink as much tepid water as he likes. When the treatment is completed, the patient is unwrapped, the blood pressure again taken, he is wrapped in dry blankets and returned to the ward, where he is kept in bed until his temperature is normal. He is then weighed and it is not surprising to learn that the loss due to the treatment is from one to three pounds. This, however, is only a temporary loss, as it is rapidly gained back after the series has been completed. Diet plays a very important part in the procedure. The meal directly previous to the treatment is very light, consisting mostly of fluids, whereas the other two meals are of a high caloric content.

Now a word about electrodes.—The first we used were made of block tin of a heavy gauge, fashioned to fit the need of the individual patient. The posterior one was rectangular in shape, while the anterior was necessarily quite different, but still with the exact amount of electrode surface area, having fimbriated edges, which made it easy to mould to the contours of the body. This was very necessary when the patient was a female. The new electrodes are links, hinged together, making them adjustable, by simply removing as many links as necessary. There are five of these, one that goes around the abdomen, like a belt, one for each arm and one for each thigh. They are attached to a connection box, which also has two connecting terminals to the machine. The advantages of the latter type are numerous, the danger of burns is lessened, the patient is more comfortable, the amount of cellucotton is less, for we use just enough to absorb perspiration, and the time of actual treatment and M. A. is greatly reduced.

The average time with the old type of electrodes was from two to three hours, while now it is from one and one-quarter to one and three-quarter hours. Instead of a maximum of 3,600 M. A. we now use between 2,000 M. A. to 2,500 M. A. Naturally, there are many dangers involved in this particular form of treatment, the most serious being burns, and I'm sure that any of you who have seen an electrical burn know how deep it can be and the long time it requires to heal. However, I am glad to say that burns are now a thing of the past, as far as we are concerned. The technician must at all times be on the alert, as a too rapid rise of temperature, a drop in the pulse rate, cyanosis and extreme restlessness in the patient often spells disaster. During the first year of giving treatments we had many unfortunate experiences, which we feel have been greatly lessened through improved technic, foolproof electrodes and the knowledge gained through our mistakes. The worst burn was located between the breasts of a disturbed, obese female, which took eight weeks to heal. Others were smaller but fully as serious.

Another complication is that of extreme humidity. Not realizing this, we continued to give treatments during the first summer and had two deaths, which occurred on consecutive days, due, it was felt to this factor. Therefore treatments are discontinued during very hot, humid days. There are two other deaths on record occurring within a few hours after treatment.

The advantages of diathermy are many. Summar-

ized briefly they are: The paroxysms are controllable, and if the patient is not physically able to continue, the treatments can be discontinued. There has been no signs of ruptured spleens; the method can be applied to any patient regardless of age, sex, race, duration of illness and degree of cooperation shown by the patient. There is no secondary disease, introduced as a therapeutic agent, to overcome. The patient is not seriously incapacitated, normal processes are not seriously affected, and drugs may be used. When necessary, we use a hypodermic injection of hyoscine, morphine and cactoid. The patient can resume normal activity within two hours after treatment.

As Dr. Perkins so wisely points out, the number of cases we have treated is still too small to permit of conclusive data. I quote now from one of his reports: "The mental symptoms in all patients who have received the treatment, and who are still living, have either shown improvement or have been held in abeyance without further signs of deterioration." In addition, our mortality rate with diathermy has been only two and five-tenths percent, whereas with malaria treatment in this hospital with the same number of patients, one hundred and fifty-six, it was eight percent. Approximately fifty percent have made a good social recovery permitting them, where conditions having no bearing upon their disease did not interfere, to return to their homes, and in many cases to resume useful social lives. As far as I have been able to observe, the patient who has a good cultural and educational background, the best environmental and social history, seems to derive the most benefit from the treatment. In other words, we can only hope to take the patient back to the point in his life where he contracted the disease.

All in all, I believe that diathermy is at present the best method of treating general paresis. I also believe that its use as an agent in the treatment of illness, such as arthritis, multiple sclerosis, asthma, and others, is rapidly approaching, and I think that here again it will prove its value. It has been indeed an interesting five years, and I am proud to have had the honor of being associated with Dr. Perkins in this work he has so successfully pioneered. I am proud too, to have had the honor of presenting this paper to this group.

Mechanical Traction for Stiff Shoulders

Grace Benson

When Mennell[1] says "from the manipulation point of view, the shoulder is the *bete noire* of the surgeon," physical therapists are quite as able to appreciate the difficulty as are surgeons for they too, rather generally experience the feeling that from a maximum of effort comes a minimum of success when the shoulder is involved. At any rate the principle of manipulation of joints during slight traction, as stressed by Mennell, has been a difficult one to apply to the peculiar mechanism of the shoulder.

During the past year we have made an effort to effect such manipulation by the combination of mechanical traction with manual and active manipulation. In almost all instances a marked increase in efficiency of movements of the arm over previous methods has resulted.

Essentially, the process is this: The arm is carried forward and upward in the sagittal plane (that is, in the arm's own medial plane) while a lateral pull of the humerus is maintained by means of a pulley and a counter traction belt, working in the body plane. A description of this technique may inspire helpful comment from other departments or technicians towards greater perfection of the method. It is with this hope that the following is presented.

The instrument first used to secure traction was the Soutter Traction unit. This device, when set up, consists of the following parts (See Fig. 1):

1. An eight foot iron rod with a ninety degree bend at a point twelve inches from the distal end, and a twenty-five degree bend nine inches from the proximal end. Each end of this bar is machined into a backward-turning hook.
2. A body-belt four inches wide and approximately four feet long, finished with a metal ring at both ends.
3. An arm belt with harness clips (3a) at both ends.
4. A set of pulleys, a fixed (4a) and a movable (4b) block of wheels; fifteen or twenty feet of rope.
5. A stay clamp on the rope.
6. A scale of the spring-balance type, graduated in pounds.

The additional apparatus necessary consists merely of a comfortably padded six foot table about twenty-eight inches high, a pillow of average size, not too tightly filled, and a chair or bench of suitable height on which to rest the distal end of the traction bar on a level with the table.

Place the patient in the supine position on the table close to the edge, with the iron bar (Fig. I, No. 1) and body belt (Fig I, No. 2) lying cross-wise under his scapulae so that the short end of the bar projects up from the table, level with the patient's chest. The pillow, used lengthwise of the table, covers both belt and bar before the patient lies down, and serves the double purpose of supporting his head level with his shoulders and keeping the bar and belt from cutting into him. Both rings of the body-belt are caught into the hook on this projecting end of the bar; that is, the belt passes from the hook down to the front edge of the table beneath pillow and patient, then up around the patient's chest at the axillary level and back to the hook—thus entirely circling his trunk and definitely holding the unruly rotating scapula tip the moment that the tightening of the pulley forces the bar to take up slack in the body belt.

Let us assume that we are to manipulate a right shoulder (Figs. II & III). The hook and belt rings just described lie to the left of the patient. The arm belt (Fig. I, No. 3) is next applied, with a center of felt padding fitting snugly against the median side of the right

Physical Therapy Dept., University of California Hospital.

arm at the axilla. (Do not allow this to slip toward the elbow even an inch.) The patient's left hand can hold this in place for the moment required for the technician to hang the scale (Fig. I, No. 6) on the distal hook of the bar which is resting on the chair. The hook on the fixed pulley block (Fig. I, No. 4a) is now caught into the ring of the scale and the rope lines are straightened over the pulley wheels as the movable pulley block (No. 4b) is drawn out toward the patient, to be attached to the harness clips of the arm belt (No. 3a). The technician's position is standing, facing the bar and pulley ropes, with

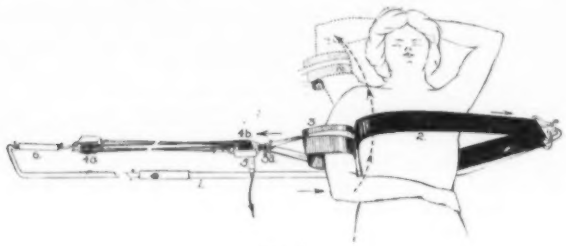

Fig I.

her right side to the table and her right hand within easy reach of the patient's right shoulder.

The patient's arm is not completely girdled by the arm belt, as this was found to be unsatisfactory because of a tendency to cut off circulation and to wring the muscles too severely against the humerus when slight rotation took place. Therefore, to prevent the belt from merely abducting the arm as the pulley cords shorten, it is necessary to hold the patient's elbow firmly against his side. While the technician's hands are still busy with adjustment of the tension of the pulley this is most easily accomplished by the pressure of her right hip (the trochanter, if the table is of the correct height) against the patient's elbow. This little maneuver brings out the necessity for having the patient lie close to the edge of the table, for there is too little standing space for an assistant to be able to exert the right amount of power at the right point.

When the desired tension is reached, set the pulley so that it will hold, by means of the clamp on the rope (Fig. I, No. 5); then, with the left hand, usually, while the right hand steadies the shoulder, grasp the patient's right elbow, not allowing it to abduct in the shift from hip to hand hold. Now, in addition to bearing a constant pressure toward the patient's body, equal and opposite in direction to the pull of the arm belt on the head of the humerus, begin gradually to carry the arm upward in the sagittal plane, asking the patient to assist actively. He will be surprised at the ease and comfort with which the arm reaches a higher point than he has previously been able to carry it.

The active stroke found most helpful both during traction and as a post traction effort, consists of flexion of the elbow starting with the fist lying on the chest close to the nipple; strive to drag it longitudinally along the chest to the side of the neck past the ear and side of the head as the elbow simultaneously opens; finish with full length extension of the arm beyond the head and as nearly parallel as possible with level of the pillow. This is comparable to shifting a log or beam from the shoulder toward the ceiling, if the patient were considered in a standing position.

The tension of the pulley must approach forty pounds before any appreciable aid to better movement

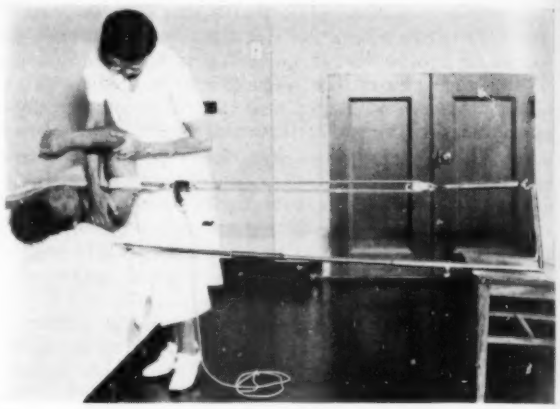

Fig. II. Showing mid-position of operation.

results; that is, the straight-out pull as recorded on the scale can be forty pounds in the average case with little or no real discomfort to the patient. The moment the upward swing of the arm begins, a slacking is noticed on the scale, and with the maximum range accomplished, the pull on the shoulder has usually lessened to about half of the reading of the scale at its first setting. This results partly from the fact that the bar often turns or rolls over causing the direction of the pull to vary slightly, as the bent portion of the distal end of the bar often faces in an opposite direction at the end of the movement of the arm. At times it is preferable not to permit this to happen and an assistant can hold this rotating end upright against such a tendency or even force it to lie back in the opposite position. Perhaps this most efficiently holds the head of the humerus backward and downward while the forward flexion is being accomplished. This, by practice, gave results which can be accounted for by a study of the following quotation from Mennell: "From the manipulation point of view, the shoulder is the *bete noire* of the surgeon, and this is mainly due to two facts. First, the movements are so wide and varied that there is always a temptation to do more than is wise, and, second, the importance of pushing the head of the humerus backwards and downwards, before forcing either abduction or flexion forwards."

Only when the patient is cooperating easily and no cyanotic or nerve symptoms occur in the arm, do we repeat this operation once or twice. It is followed by sim-

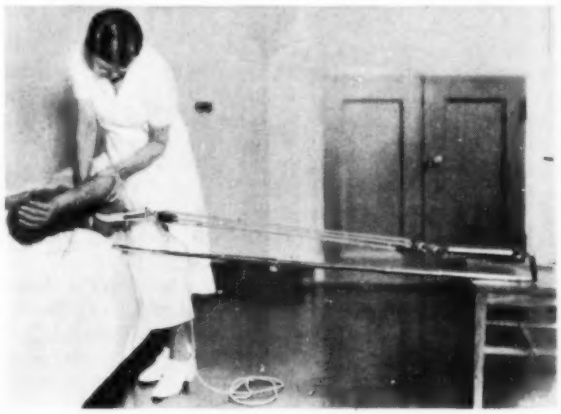

Fig. III. Showing final position of operation.

ple manual abduction and rotations to the full limit of comfort after freeing the arm from the arm-belt but with the body-belt still in place. Much of the success in all of these efforts depends upon the degree of relaxation obtained through the whole shoulder girdle during passive movement and often this can be maintained or regained by fitting a palm gently over the shoulder in a slightly pressing or holding attitude while the other hand and arm contrive the desired movement. Under no circumstances must there be a leverage-drag of the patient's forearm during any position of the various manipulations, for this immediately will start contractions in several groups of muscles. Getting the patient's confidence the first time, convincing him that he is not going to be forced to painful limits and yet giving him evidence that he is increasing his range, generally result in his ability to relax better and tolerate a greater tension after first or second trial.

There has been much discussion recently, by many authorities, of the intricacies of the shoulder joint, with the result that many of the earlier teachings have been abandoned for newer conceptions. Abbott[2] emphasized this recently. X-ray and fluoroscopic examinations of the shoulder through the full range of motion of the arm (as suggested by Abbott) have demonstrated not only the expected movements of the scapulo-humeral joint, but the simultaneous movements of the sterno-clavicular and the acromio-clavicular joints, in accomplishing certain positions.

A very good analysis of the relative parts played by these three joints during the elevation of the arm is given by Codman[3] whose extensive work also contains interesting data on the terminology of the many movements of the arm, which are far from being standardized. For example, abduction is movement of a part away from a median line. Pure abduction of the arm then, can never exceed ninety degrees, as the arm is approaching the median line when it leaves the level of the shoulder in rising higher. Codman terms movement of the humerus above this point toward the head, superior adduction, and below and forward over the chest, inferior adduction.

Noting that anatomists agree so heartily on the value of rotation in assuming these different positions of the arm, and that few technicians are using definite methods of measuring or recognizing pure rotation or even the neutral position of the axis of the humerus, it is fitting to include here a plan for a definite recording of both internal and external rotation in abduction. The increase in these arcs probably is the biggest factor in increasing motion, by whatever type of manipulation. For neutral position "The rotators of the shoulder are at rest while the limb hangs at the side, the forearm in mid pronation and the thumb facing directly forwards."[4] Raising the arm through an arc of ninety degrees sideward from the foregoing position admits of no rotation whatever, provided the back of the hand faces the ceiling. Still holding the back of the hand up, bend the elbow ninety degrees and note that the shaft of neither the upper nor the lower arm has rotated in the least. With the arm held thus, take a position at a wall so that the tip of the elbow and the whole ulnar border of the forearm and hand coincide with the wall plane at the level of the shoulder. This is the zero position of neutral rotation of the humerus in abduction. Swinging the forearm upward and backward against the wall, through an arc of approximately ninety degrees from this zero position, is pure external rotation (See Fig. IV); about ninety degrees forward and downward is pure and complete internal rotation in the average person (See Fig. V). This is very apparent if a pencil is grasped in the closed fist and this arc of motion is actually described on the wall; the forearm is the radius and the elbow the pivot of the compass shaft. Instead, however, the protractor may easily be applied directly to the arm and the angle read at once.

The definite relation of limited rotation to the more intricate limitation of movements of the arm cannot be discussed at this writing though the study of this problem would doubtless prove to be both interesting and helpful. Suffice it to say that the defects of rotation of stiff shoulders—caused by lack of use following chronic or subacute arthritis or bursitis, or injury—seem to lessen noticeably after treatment consisting of some form of heat, progressive manipulation and exercise. Of course patients are directed to augment treatments with definite home exercises to increase strength in the newly acquired positions.

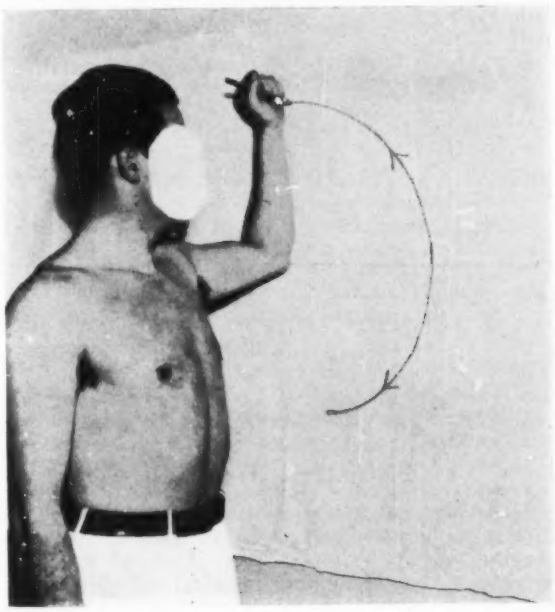

Fig IV.

We might sum up the advantages of the mechanical traction over manual manipulation in this way: Confidence of the patient that no sudden movement is coming permits general relaxation, while the steady pull through the joint decreases local spasm and admits of a stretch of the capsular ligament. Unless a more prolonged stretch of the capsular ligament is indicated, the whole operation does not take over ten minutes when skill in handling the instruments has been acquired. On the contrary, enough power applied manually, for a sufficient length of time and to act in the several directions necessary to accomplish the same results, is practically impossible even with the help of an assistant because of the transfer to the patient of the tension required on the part of the technicians. The increase in motion in all directions is definitely more rapid and more complete than under manual effort alone, also less painful to the patient. Some conservative technicians, no doubt, feel that a non-manual force, used in an effort to release unresisting adhesions or muscle spasm will defeat its purpose because it *is* non-manual. They assume that it is less easily gauged and

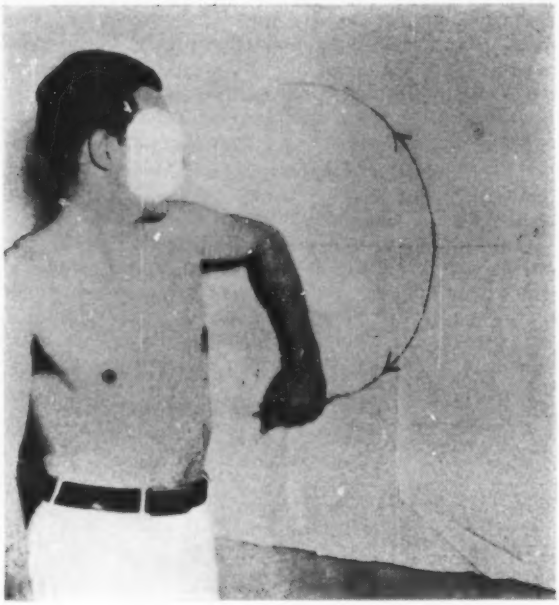

Fig. V.

consequently involves more risk of injury to the structures treated. At the University of California Clinic we found the patients themselves ready to advise a new patient to accept this method because it accomplished more with less pain and this in turn has encouraged the technician.

This wordy description of a comparatively short and definite procedure makes it seem more difficult than it really is. The average technician not mechanically inclined, will find the handling of the instruments difficult at first, but striving to be methodical in this part will make the work seem simple after a short time. Perhaps the most valuable preparation consists of a few lessons from a painter in stretching pulley ropes out and tying them in an orderly knot to prevent tangling.

The effects of this stereotyped Soutter traction may easily be duplicated by supplying oneself with pulleys, rope and scale and by having a machinist turn the iron rod to measurements, and a brace man make the belts. The stay clamp is not essential as the required tension stay can be accomplished by looping the rope under the taut strand on the adjoining wheel. The trade article is better finished and is portable because the bar is jointed like a fish rod. A wide awake technician with limited floor space substituted, for the bar, wall rings in which belts and pulleys were clamped. This apparatus supplied adequate counter traction.

1. Mennell, Jas. B. Physical Treatment—by Movement, Manipulation & Massage, 3rd Edition. P. Blakiston's Sons & Co., Inc., Page 242.
2. LeRoy Abbott, M. D. Remarks on the Motion of the Shoulder Joint—The Physiotherapy Review, Sept.-Oct., 1933.
3. Codman, E. A., M. D. The Shoulder, 2nd printing. Thomas Todd Company, Boston, Massachusetts. 1934. Page 41.
4. Mennell. Page 290.

Persistent Hiccough

This distressing and exhausting condition, due to Phrenic nerve disturbance, so often met with in hospitals, can usually be much relieved and often entirely cured by the use of surging sinusoidal electricity. It is well, if possible, to give a short diathermy treatment first, followed by the sine current. The plates for both machines should be placed one at the back of the neck and the other on the epigastrium and the current worked up to considerable intensity, different, of course, with different machines. The patient usually feels relief at once but sometimes the effect does not occur until the treatment is stopped. It is well after about seven or ten minutes to give the patient a rest and repeat later if necessary.

MAY GOODALL DARROW.

EDUCATING THE PUBLIC TO PHYSICAL THERAPY

The following excerpts are from a paper presented for an English project by a fourteen year old girl in the ninth grade. Her project was "A Vocation for Women." Her choice of vocations about which she studied and wrote was physical therapy; this because her mother had a fractured wrist and was receiving treatments.

Physical therapy must be recognized as a definite part of medicine, to be practiced and controlled by graduate physicians. It should be used only as one of the quadrad of medicine, surgery, psychiatry and physical therapy. It should be prescribed only after careful physical and laboratory examinations of the patient have been made. It should never be prescribed except by a physician thoroughly trained in the use of physical agencies.

After discussing the history, the training and the field of physical therapy she concludes with:

In physiotherapy the physiotherapist makes her money according to the number of patients she has. For massages on broken arms, legs, hips, etc. she charges from $5.00 to $7.00, according to the condition of the case. For other treatments she usually charges from $4.00 to $6.00. In very severe cases such as where a person was born with one leg shorter than the other and where an operation has taken place to stretch the bone the price is very high.

Other treatments or diseases that are quite expensive to the patient are Carcinoma of Bones, Leopold Jaches, Diseases of the Spine, Skull and Brain, Gastro-Intestinal Tract, Tuberculosis, Diseases of Thorax, Diagnosis of the Heart, and Radiosensitiveness of Cells.

She received an "A" for her project!

Measurements in Physical Education and Physical Therapy

Wanda Bowman Wilson

The path leading from philosophy to science is one of progress from scattered and perhaps inaccurate measurements on only certain aspects of a problem, to more and more accurate data. At first information is scarce and the elementary relations between important factors obscure. But from analysis, discussion and comparison of even a small amount of data lacking in accuracy, a clue will be discovered which will indicate the right direction in which to work. Then more and more measurements are made, and experimentation may begin. Finally, synthesis is possible and the picture unfolds. It is possible to predict results.

Measuring and recording are of great value in the field of corrective exercise to discover and advance its technique. For example, gradation of exercises or progression is a subject much discussed, but not fully evaluated. And yet, the phraseology itself suggests measurement of progress. Again, one of the major problems is to find the most efficacious, safe exercises for a specific corrective problem. Greater knowledge of each exercise and its specific effect upon each area of the body should give more rapid results.

Probably physical therapy, as well as medicine, will never reach the state of perfection of scientific development to which electronic physics, for example, has reached today. Yet, in certain fields, particularly that of the problem of muscular development, sufficient experience has been gained to demonstrate one promising path.

It is the purpose of this discussion to point out certain of the problems and how measurements have been and are being used to develop effective methods of testing and evaluating individual exercise programs. These have limitations in many ways, but they represent one beginning step at least.

When measurements are taken, there should be an understanding of the purpose and scope. In this particular field the following objectives may be established:

1. Means of establishing the initial muscular condition of an individual to facilitate the planning of a program for him and to give a record of the starting condition.

2. Subsequent check data to determine the effectiveness of the treatment and the change in the condition of the individual.

3. These different sets of measurements will give the time rate of change. The time interval is also necessary to evaluate the program.

4. After a background of data has been accumulated, it might (and probably would be) possible to correlate normal measurements with other parameters such as (possibly) height and strength.

In the case of the last item, the results would be neither an average nor a theoretical ideal. However, they would be the measurements which have been attained by a large number of quasi-normal individuals who have executed a program of exercises chosen and designed to affect particular muscle areas.

Theoretically, such norms must have tolerances. It is impossible to say all individuals the same height should be of the same relative proportions, but it should be possible to determine the bracket within which the measurements should lie. Such tolerances would allow for such individual variations as skeletal deviations. It is conceivable that by the study of a large number of cases these second order effects could likewise be evaluated. As an example of this work, it has been determined that for mature women five feet, four inches tall, the norm, as explained above, for the hip measurements is: 36¼ ± 1¼".

There are, of course, many types of measurements available and being used in physical education and physical therapy. One of these—the measurement of body circumferences—seems to possess several advantages. One of these is simplicity. No elaborate equipment is required. Six to ten minutes is the maximum time needed for the skilled "measurer." An accuracy of plus or minus an eighth of an inch is possible, which gives a percentage accuracy of 1.5 percent or better. This is ample for many purposes and compares favorably with engineering data. One disadvantage, when used alone, is that it does not permit the grading of habitual segmental deviations.

As to method of procedure, landmarks must be established which are easy to find and accurately duplicable. These may be placed on bones, or the origin or insertion of muscles. In a few cases, the maximum or minimum measurement should be taken. For example: The ankle circumference is taken directly above the malleoli. The upper arm is taken at the insertion of the deltoid, with the arm held horizontal. The calf is measured at the maximum, whereas the waist is the minimum measurement directly below the ribs. The hip permits of at least two measurements using the bony prominences as landmarks.

The chest, waist and abdomen present different problems. Landmarks are easy to find, but there are ever varying measurements due to factors such as digestion, respiration, fatigue and mental condition. To obtain duplicability, these factors must be eliminated or compensated. Thus experience shows it is possible to repeat measurements of the waist and abdomen over a period of several hours, even before and after meals, when the individual is placed in the hanging position. However, such a test is inapplicable if the ability to hold this position for several seconds is lacking.

The chart gives a form which has been found useful. All measurements are taken standing, flat-footed, weight on both feet evenly. The location of the measurements is as follows:

Neck. Base of neck, at the level of the sixth cervical vertebra.

Chest. Underneath the arm, arms normal.

Bust. This measurement is satisfactory only if the

Mr. and Mrs. Wilson took part in the Panel Discussion on Body Mechanics, at the Atlantic City convention.

breasts are not pendulous. The nipple should be at the level of the fifth thoracic vertebra. The length is the distance from the clavicle to the nipple.

Thorax. Just below the bust (about 7th to 8th thoracic vertebra).

Upper Arm. Maximum circumference obtained below the insertion of the deltoid muscle.

Lower Arm. Maximum circumference just below the elbow.

Waist. Below the last rib. This should be the minimum circumference. This measurement is repeated with the maximum contraction of the abdominal muscles.

Abdomen. At the crest of the ilia at the sides and the fourth lumbar vertebra in the rear.

Hip. Several measurements have been found useful. One is at the symphysis pubis in front and the fifth sacral vertebra in the rear. A second is at the great trochanters. This should be the maximum circumference. If it is not, then a measurement is taken at the maximum.

Upper Thigh. Just below the gluteal fold. This should be the maximum circumference.

Lower Thigh. Just above the knee-joint. This should be the minimum circumference.

Calf. Maximum circumference.

Ankle. Above the malleoli.

Shoulder Height. This is taken standing, and only when there is any obvious difference. The acromion process is used as a landmark.

Shoulder Breadth. The bi-acromial diameter is used.

The columns are provided for the original data and also for the changes which have taken place. In addition, space is provided for the measurements which are set up as objectives. Usually, but not always, these are the norms for the height of the individual.

In themselves, such measurements are not new. They have been used for anthropometrical purposes for years. However, they are well adapted to use as experimental checks in tests of the efficacy of exercises. In such a case, the records of measurements lose much value unless careful records are kept. Here a careful check of the strength of each muscle group should be made and recorded. This may take the form of the exercise or exercises the individual can perform initially. As the work is changed and made more difficult, a notation of date, the number of treatments and the new exercise should be made.

Frequent measurements should be taken for the purpose of change of exercise and measurement. Changes in the order of ten percent—a loss of two and one-half to three inches in the case of the abdomen and hips, and one to one and one-quarter inches on the upper arm—in a period of three weeks are frequent. These are due to exercise alone, and not to diet, as the changes downward of weight are small; where the trend is upward the changes are more gradual.

EXPERIMENTAL RESULTS

A considerable amount of data has been obtained over a period of eight years of use of this method. The individuals were mostly adult women who might be classified as quasi-normal. In other words, there were no major problems of a corrective type, but merely muscular atrophy with consequent changes of body proportions due to age, occupation and lack of use of the body. Then some weaker individuals were recorded.

It has been found through the study of these quasi-normal bodies that many lighter exercises can be developed which are applicable to the weaker individual. It seems likely that further work would lead to the way to handle the orthopedic cases of certain types. A great many common exercises were tested in this way. Many new ones were created when it was found that the usual ones produced no measurable change in a period of a few months. On many individuals, it was found that circumferences increased in one section of the body, such as the chest and arms, and decreased in other portions, for example, the abdomen and hip. In the case of the weak, thin individual, the measurements trended upward; and on the adipose type the trend was downward. Interpreted in another way, under effective exercise the body tends to proportion itself correctly.

The time factor has been, and is being tested in the following way: Different programs were arranged for various individuals, each program designed to affect the same specific area. Records were kept of the number of times each exercise was executed, and of the frequency of the treatments. From these records certain exercises were found to be effective and others semi- or non-effective. By casting out the ineffective, progress in results has been constantly speeded up. The reasons why are beginning to emerge, and the theory of progression is beginning to become more clear. Such factors as the order of exercises in the lesson have also been studied, and can be further studied by this method.

CONCLUSIONS

On quasi-normal adult women's bodies the following has been accomplished:

1. A method of measuring body circumferences has been established which gives a definite indication of changes in size of muscle. It is capable of reasonable precision and is duplicable if the landmarks are correctly chosen.

2. Normal measurements for certain body circumferences have been plotted and tested. These show a large number of cases to fall within the tolerance brackets.

3. It is possible to predict the approximate change in measurement at a given circumference by the application of a series of exercises designed to affect that specific portion of the body.

4. A series of graded exercises are being tested. The results are sufficiently gratifying to date to indicate the possibility of establishing carefully graded, kinesthetically and physiologically correct, safe graded series of exercises for various portions of the body. In this work, the psychological factor is considered, so that the exercises are pleasant and the usual resistance to the idea of "gym" reduced.

5. Body proportions tend to show a correlation with muscular tonus and strength.

6. Exercises are most effective when carefully matched to the individual's strength.

FUTURE WORK

Much more work needs to be done. More cases are required to continue the process of gradation and to establish more norms. The tests should be extended to embrace weaker cases. At the present time the conclusions cannot be extended to cover men, due to lack of data. Neither are they applicable to children, without

far more information, due to the changes of circumference with growth.

Up to the present time, most of the cases have been taught individually. Some experiments have been made in groups of two and three. A further study of matching individuals and grouping would lead to more practical utilization of the instructor's time.

Finally, measurements, evaluation of data, and more measurements are needed to tread the path from philosophy to science, or to be more accurate at the risk of redundancy—quasi-science—in the field of physical education, corrective exercises and physical therapy. A few minutes a day for records, ten minutes a week for measurements should give food for thought, bring about discussions and finally a better comprehension of the whole.

Physical Therapy in an Industrial Hospital

C. H. Ogden, M. D.

Physical therapy has, I believe, developed hand in hand with medicine in industry.

Industrial medicine had its recognized conception with the passage of the workingmen's compensation acts in the various states. At the start, cost was the predominating factor rather than the character and quality of the work. The service rendered was limited to first aid and hospitalization of the injured. It became apparent as time went on that the character and quality of the service rendered and the personality of the staff were really the important factors. Along with this realization came the extension of the service to include sanitation, preventative medicine, physical examinations and physical therapy.

At the start, physical therapy in industry was limited practically to massage and passive motion and it was not until after the world war that the greatest strides were made in physical therapy.

As in industrial medicine so in industrial physical therapy, the physical therapist is the important factor. Training, tact and personality are prerequisites.

In industry all creeds, nationalities and personalities are coming to us through no choice of their own, and it is up to us to show a personal interest and secure their co-operation. In our contact they are not all Johns, but John is John and Paul is Paul.

It is not the purpose of this paper to discuss physical therapy technique, but it is not amiss to briefly re-state the basic principles which apply: 1st To increase circulation; 2nd, Increase muscle tone; and 3rd To educate the patient to carry on these procedures at home.

The apparatus is a secondary consideration to the above factors and has its place in industry only after it has met the standards of the American Physical Therapy Association and approved by them.

In industry the nature of our cases are just a little different in two respects: we are not confronted with the infantile paralysis, tabes, and chronic arthritis deformities requiring time and patience, but rather a reversal of the order in that we are expected to return the patient to his occupation in the shortest consistent interval practical.

For we have the auditor watching the costs of a non-productive department on one side of us and the safety man watching his time lost record on the other.

Likewise in private work we have the patient striving as much as possible to shorten his period of disability while in many instances an industrial patient is in no particular hurry to return to work, particularly if during these present times he is working only part time. He is a good deal like a cartoon I saw the other night of a workman who claimed he was working for $2.00 a week as when he was on the relief he got $14.00 a week and when he was working he got $16.00 a week. Q. E. D. Therefore, he was working for $2.00 a week.

Nor is the industrial patient going to brag of good functional results until he has completed his settlement.

It is the aim in industrial physical therapy to bring the fractures of the lower extremity to the weight bearing stage with full active motion of the injured part.

In an industrial hospital, fractures of the small bones of the extremities constitute by far the largest number of cases treated in the physical therapy department; and while they may appear trivial in the physical therapy role as a whole, yet they demand the fullest interest and effort, for in terms of settlement paid for permanent disability, they constitute a considerable sum in the course of a year.

As in medicine so in physical therapy there is no class of cases treated requiring more complete and detailed records than those of industry. The record must include a full description of the condition and amount of motion at the time of admission to the department, and a full weekly progress record and a detailed description of condition on discharge, including active and passive motion and patient's claims when discharged.

In conclusion I would suggest that in an industrial establishment not having sufficient work to warrant the employment of a registered technician, and likewise in the smaller hospitals in which the number of industrial cases does not warrant the employment of a full time technician, that the work could be accomplished best by a technician working out of and under the direction of a physicial therapy laboratory of high standards, and ambulatory cases could be referred to these laboratories just as eye and neurological cases would be referred for specialized treatment and reports.

Director of Physical Therapy, Illinois Steel Company, Gary, Ind.
Presented at the Tri-State Hospital Assembly, American Physiotherapy Association Section, Chicago, May, 1935.

A Self-Maintaining Physical Therapy Department

C. O. Molander, M. D.

The Department of Physical Therapy at Michael Reese Hospital has had a rapid rise within the past five years. It is more than self-maintaining. It has proven to be a valuable clinical and financial asset. It has now taken its place on an equal footing with the other departments in the hospital, and occupies a place of esteem. The staff gives us every opportunity to assist whenever and wherever physical therapy is indicated.

Five years ago little attention was directed toward physical therapy in Michael Reese, but today it is recognized as an indispensible unit. However, little could have been done without the farsightedness and intelligent support of our superintendent, Dr. Herman Smith, and of our president, Mr. Alfred C. Meyer.

In order that you may have a clear picture of just what has happened within this five year period, it is well to draw a sharp contrast showing you just what we had in the year 1930 and what we have now in the year 1935.

In 1930 there was only one room and one technician on the private side, treating from five to eight patients daily. On the clinic side we also had only one technician and treated an average of twenty patients per day. In conjunction with the physical therapy clinic there was a curative workshop with one occupational therapist in charge. Also, there were very fine general occupational therapy and pediatric occupational therapy divisions.

Take this picture just described and note the marked contrast five years later, in the present year of 1935.

We now have two private divisions, one located on second floor of Michael Reese, Main Hospital, and the other on first floor of Meyer House, the elite division of the hospital to which we have just moved. The main hospital division is devoted largely to specialty work such as corrective gymnastics, Hubbard tank work for underwater gymnastics, hyperpyrexia, rhythmic suction apparatus for vascular disturbances of the extremities, colonic irrigation, and other phases of work which are now in the developmental stage. It has six rooms. The division in Meyer House is equipped to give all general treatments with physical agents, and consists of ten rooms.

Our personnel now numbers seventeen, and includes the director of the department, nine physical therapy technicians, one full time secretary, one part time clerk, four occupational therapists and one full time attendant.

From the standpoint of function we now have the following subdivisions:

1. Organization and Administration.
2. The Industrial Division.
3. The Division of Individual Gymnastics.
4. The Underwater Gymnastic Division.
5. The Hydrotherapy Division.
6. The Hyperpyrexia Unit.
7. The Ultra Violet Light Unit.
8. The Teaching, Study and Research Unit.
9. The Photographic Unit.
10. The Library Unit.
11. Electrotherapy.
12. Specialty Units:
    a. Electro Surgery.
    b. Skin.
    c. Gynecology.
    d. Eye, Ear, Nose and Throat.
    e. Genito-Urinary.
    f. Relaxation.
    g. Colonic Irrigation.
    h. Rhythmic Suction Apparatus.

This functional organization of the department covers all phases of physical therapy and unites each of these divisions into a well organized whole, giving to the staff, the best in this field.

How was this accomplished?

It was realized, first of all, that Michael Reese had an unusual setting for a successful physical therapy department. Investigation of existing conditions at Michael Reese were conducted, and surveys of other large hospitals throughout the country were made and analyzed. As a result of these investigations, a plan of procedure was evolved, incorporating the best in the field of physical therapy. This plan was then presented to Dr. Smith, our superintendent, and approved by Mr. A. C. Meyer, president of our board, both of whom saw the great opportunity which lay before us in this field.

In 1931 the third floor west, main hospital, was opened, giving us seven rooms, three technicians and sufficient equipment for the needs of the department. In 1932 a full-time secretary was added. In 1934 five additional rooms were acquired on second floor west, main hospital; three additional technicians; more up-to-date equipment; and a complete gymnasium and a third Hubbard tank. In March of 1935 we added another technician, a full time attendant and moved into the larger, more luxurious quarters in Meyer House.

The success of this rapid rise is due chiefly to the following reasons:

1. No patients are given treatment unless they have been referred by a doctor. The doctor is kept in touch with regarding the patient and in this way does not lose his case.
2. We have been able to obtain and hold the confidence and good-will of the patients.
3. There has been a specialization of personnel. Each technician has been assigned special tasks and has become unusually competent.
4. The technical personnel has been taught to smile and to preserve an attitude of friendliness combined with sincerity. They maintain an interest in every individual case.
5. The acquisition of the most modern and up-to-date physical therapy equipment.

Director of Physical Therapy, Michael Reese Hospital, Chicago.
Presented at the American Physiotherapy Association Section of the Tri-State Hospital Assembly, Chicago, May, 1935.

6. Each year a plan of organization, development and technic is drawn up. The development of our department is in accord with this plan of procedure.
7. New ideas have been investigated by research with other departments. The good retained and the worthless discarded.
8. The department has had the enthusiastic backing of the Superintendent and Board of Directors; the Staff; the Woman's Board; the various committees and societies; the internes and the nursing group.
9. Careful attention has been paid to details.
10. Weekly meetings of technicians have kept this group informed on the latest methods of technic.
11. A plan of administration in finance, room assignments and appointments has been developed and is working efficiently. This co-ordinates all physical therapy and occupational therapy divisions.
12. Physical therapy is kept before the staff by lectures and demonstration programs to the staff, to the internes and to the nursing group, and has produced a physical therapy consciousness among them.
13. An operating room service in the field of surgical diathermy is maintained and is on call twenty-four hours out of the day to assist the surgical group.
14. An optional service for internes for one month periods is given, and to date a number of internes have availed themselves of the privilege.
15. Accurate records of our work are kept which checks conditions on admission, progress of all cases, and notes final condition on discharge.
16. All physical therapy and occupational therapy is under single management.
17. The Director is on the teaching staff of a medical school, and thus gives instruction to physicians, medical students and technicians.

The aim of our department of physical therapy at Michael Reese is to build a smooth, progressive, well balanced and co-operative unit which will serve the patients of the hospital in an efficient manner, and present to the hospital staff, the nurses and the technicians a teaching research program which will help to clarify the many debatable points now existing in the field of physical therapy, thereby placing it on a par with the other divisions of medicine and surgery.

However, in looking ahead we realize that if our future is to be assured, we must be more than just an ordinary physical therapy department. Research and investigation in this field must occupy an important place. The research project is not an idle dream but will be eventually an important part of our program and be headed by a competent research director. We anticipate the addition of a new pool for underwater gymnastics and a division of nervous and mental diseases with a very complete hydrotherapy unit. The completion of our ambition is a five story building devoted entirely to physical therapy and occupational therapy.

In conclusion, it can readily be seen that such advances could never have been made if the department had not been on a self-maintaining basis.

Medical Meeting

The first annual meeting of the newly formed Mississippi Valley Medical Society will be held at Quincy, Ill., October 2, 3, 4. The meeting and commercial exhibit will be held in the new and thoroughly modern Lincoln-Douglas Hotel. There will be morning, afternoon and evening sessions of a most practical character. The entire program is arranged to especially appeal to the general practitioner.

Among the eminent clinicians on the program are:

Isaac A. Abt, M.D., Prof. of Pediatrics, Northwestern University School of Medicine.

Fred H. Albee, M.D., Prof. of Orthopedic Surgery, New York Post-Graduate Medical School and Hospital.

W. Wayne Babcock, M.D., Prof. of Surgery, Temple University School of Medicine.

Hugh Cabot, M.D., Prof. of Surgery, University of Minnesota Graduate School of Medicine.

Arthur C. Ernstene, M.D., Cardiologist, Cleveland Clinic.

Frederick A. Figi, M.D., Associate Prof. of Laryngology, University of Minnesota Graduate School of Medicine.

Thomas E. Jones, M.D., Gynecologist, Cleveland Clinic.

Wm. C. McCarty, M.D., Prof. of Pathology, University of Minnesota Graduate School of Medicine.

Albert Soiland, M.D., Chairman, Malignancy Board, California Hospital of Los Angeles.

These men will each give two or three practical lectures or clinical demonstrations and will be assisted by twenty-seven specialists from Illinois, Missouri and Iowa who will conduct a clinical lecture course. There will be a total of over fifty lectures and demonstrations for the three day session. All ethical physicians are cordially invited to attend the meeting, and a detailed program may be obtained from Harold Swanberg, M.D., Secretary-Treasurer, 211-224 W. C. U. Building, Quincy, Ill.

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The Physiotherapy Review

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Attention, Members

Some time ago, the executive committee sent out questionnaires to all members, for the purpose of obtaining a membership roster. Only about fifty per cent of these forms were returned. The Executive Committee now urges all who have not returned them, to do so at once.

At the convention in Atlantic City, it was decided to eliminate the annual membership list in the Review. The Association's membership is, after all, a private affair and need not appear in the journal, the readers of which are not restricted to membership. Instead of publishing the list in the Review, the executive committee will prepare a pamphlet which will contain the names of all paid-up members. It will contain the names, addresses and professional connections.

Therefore, all members whose names are to appear in this pamphlet are asked to send in their questionnaires —unless they have already done so—so that the executive committee may have the proper data. These questionnaires should be returned as soon as this issue of the Review appears. The secretary can furnish more blanks if necessary.

By Your Works

At the convention in Atlantic City, Dr. Amsden (his paper also appears in this issue) in his talk on *Physical Therapy in Mental Hospitals,* gave to physical therapists some very good suggestions in the matter of handling mental patients. But, while his talk had to do with mental patients only, his suggestions may well be applied to almost any phase of physical therapy; for whether the patient is mental or otherwise, there is always an appropriate psychological approach to that patient. And if a mental patient "sizes up" his worker, how much more may one expect to be appraised by a patient with a normal mind!

Much has been said—many times in these pages—about the attitude of those working in physical therapy; yet more can still be said without over-estimating the importance of this. The physical therapy worker may, at any time, meet with, or, more unfortunate, fall into one of two pits: under-enthusiasm or over-enthusiasm.

Physical therapy, while old as medicine, is yet a new thing. Although Hippocrates made use of the science, the modern generation heard very little about it until the time of the World War. Since then, physical therapy has become a new term. Patients with all sorts of ills will always flock toward a new "cure," just as soul-sick persons will seek for a new religion. It is for those working in physical therapy to avoid flashing the electric sparks, so to speak, before the eyes of the ready-to-believe patients, and instead, to make and keep the profession sane and sober and honest. Only thus can it take and maintain a proper place in the field to which it belongs.

But while over-enthusiasm may smother and choke the profession, on the other hand, a phlegmatic attitude can put it on the anemic list and even bring it to its death by slow degrees. It is not enough to perform the daily task "dutifully"; behind the scientific gesture must be personality for the patient, and underneath it, a healthy enthusiasm for the profession.

In concluding his talk, Dr. Amdsen said: "The elevation of this practice must, in a large measure, lie with you."

Marguerite Hentsch

We regret to report the accidental death, from a fall, of Miss Marguerite Hentsch, a valued member of Northern California Chapter. She returned to England last autumn to visit her family and to do observation work in the London Hospitals where she had previously been associated. Miss Hentsch was a graduate of a Canadian hospital in nursing and physical therapy. She came to California where for eight years she was an active and conscientious worker at Woodland Clinic, Richmond and Berkeley. All who knew her will regret her untimely death.

Ethel Johnson Dombaugh

On Sunday, July the twenty-eighth, Ethel Johnson Dombaugh died rather suddenly at St. Francis Hospital. The trouble was evidently a septicemia, resulting from a deep sinus infection.

Mrs. Dombaugh has been a member of the American Physiotherapy Association for a long while, and has served in various capacities in the organization. Her work in physical therapy was excellent, and those who knew her well have the greatest praise for her. The Association regrets her going, and the Northern California Chapter, especially, will miss her.

ABSTRACTS

John S. Coulter, M. D.

Tissue Heating by Short Wave Diathermy

Bernard Mortimer, Ph.D., M.D.; Stafford L. Osborne, B.P.E., in J. A. M. A., April 20, 1935, Vol. 104, pp. 1413-1419.

The chief claims for short wave diathermy revolve about the following points:

1. Greater and more uniform penetration of heat into the body.
2. Special selective thermal action.
3. Specific biologic action.
4. Specific bactericidal action.

Summary and Conclusions.

Experiments have been performed on twelve anesthetized dogs and on the thigh of eight human subjects to study and measure the heating effects of short wave diathermy and to observe any other changes that might occur. Five short wave machines were used, a 6 meter, 15 meter, 16 meter, 24 meter, 25 meter and the conventional spark-gap diathermy.

1. There is no conclusive evidence from the literature nor were we able to substantiate the claim of specific biologic action of high frequency current (short wave diathermy). In our opinion the burden of proof still lies on those who claim any biologic action of these currents other than heat producing.

2. The experimental work that claims specific bactericidal action for these high frequency currents may be more rationally explained, we believe, on the basis of "point heating," which raises the temperature of the micro-organisms above their thermal death point without a corresponding elevation in the temperature of the medium. It still remains to be demonstrated whether such test tube results can be secured with infection in the body.

3. Our own work on the machines submitted shows that there is a thermal gradient from the hot skin to the less hot tissues within.

4. There is no evidence from reliable experimental work on living subjects that short wave diathermy possesses a more uniform penetration of heat into the body than the conventional diathermy.

5. The possibility of special selective thermal action is a very remote one.

6. We do not believe that it is possible to predict the response of the body to high frequency currents from phantom model or other in vitro experiments.

(Reprints of this article can be secured from the Council on Physical Therapy of the A. M. A.)

Burns, Produced by Radio Short Wave and Ultra-Short Wave Therapy

And Their Prevention

David H. Kling, M.D., with a Case Report of a Severe Burn, by George O. Berg, M.D., Los Angeles, in J. A. M. A., 104:22:1981, June 1, 1935.

Radio short wave and ultra-short wave apparatus is now extensively advertised and has begun to replace diathermy. At the high frequencies generated by these machines, ranging from ten to a hundred million oscillations per second (equal to wave lengths of from 3 to 30 meters), it is not necessary to apply the current directly to the body through metal electrodes as in diathermy. It is sufficient to place the part to be treated in the electrical field between insulated plates. Heat is generated chiefly by displacement currents within the tissues, which act as a dielectric.

The Mechanism and the Prevention of Burns

On the basis of observation and experimentation, the following factors seem to be responsible for the production of burns in the short wave electrical field:

The surface effect.—It was found on cadavers that, for every rise of 1 degree centrigrade in the femur, the temperature of the skin of the thigh rose 6.4 degrees.

The interposition of air between electrodes and skin, producing an enormous loss of energy, forces the employment of powerful apparatus in order to treat efficiently; on the other hand, it is the surest means to eliminate the danger of surface accumulation of heat. Compared with the high resistance of the air, the differences between the tissues become very small; this makes the heating of the skin conform to the heating of the deep structures. None of the burns occurred with air gaps. For the prevention of the accumulation of heat on the surface, the necessity of suitable distance of the electrodes from the skin is evident. This gap should be filled out by a good insulator that does not heat up under treatment.

Size of electrodes.—The smaller the electrodes, the greater is the density of the electric field and the greater therefore, the heating effect. With the apparatus previously mentioned but with electrodes three times as large applied directly to the 1-inch thick board, the increase in temperature in two minutes amounted to only 5 degrees C. It is therefore necessary to decrease the energy of the apparatus or, better yet, to increase the distance of the electrodes from the skin in treating small areas such as the fingers or the teeth. Too little distance, with a very small electrode was responsible for the burn over the nail in Case 1.

Perspiration.—Sweat contains electrolytes which transform the surface of the skin into a good conductor and decrease its resistance. The density of the field is therefore greater in the moist surface. This causes overheating and eventual burns.

The Acro-effect.—This term, from the Greek, extremity, designates the action of a short wave electrical field on pointed parts such as the nose, ear lobes, finger tips, bony protuberances such as the olecranon tubercle of the tibia, spinous process of the vertebrae, and base of phalanges. Here the areas are reduced to a minimum; the concentration of energy therefore is at a maximum; the pointed parts act like antennae. They were the common locations of the clinical as well as the experimental burns. This concentration of current in pointed parts occurs even when they are in the middle of the field at the greatest possible distance from the electrodes. It is often noticed in treating both knees, by application of the electrodes at the outside of each knee, that the patient feels overheating first at the inside of the knees, owing to the concentration of the field in the pointed protuberances of the medial condyles of the tibias. The greatest care must be taken to protect

protuberances in every part of the field. By proper distance and padding, the density of the field is made to spread homogeneously over the whole treated area. The nose is made level with the surroundings, the ears are strapped to the skull and the gaps between the tibias are filled out.

Summary

The widely circulated assumption that the use of condenser electrodes in short and ultra-short wave therapy excludes burns and simplifies the technic is a dangerous fallacy.

In six cases, three each of second and third degree burns, the first group produced slow healing blisters, the second total necrosis of the skin.

Burns were produced in rats, ranging from edema to gangrene and loss of ears, limbs and tails.

Sufficient energy, proper electrodes and distance from skin, absorption of perspiration, and constant control of patient and apparatus are imperative in order to prevent damage and derive the benefits of short and ultra-short wave therapy.

Short Wave Diathermy

Preliminary Report

Frank Hammond Krusen, M. D., Philadelphia; in J. A. M. A., 104:14:1237, April 16, 1935.

Within the past year there has been an enormous sale to the medical profession of a new type of high frequency apparatus. This device has been advertised as a distinct improvement over the old type "long wave" diathermy machine. Used at first for producing general fevers, the appliance is now being sold for the production of local heating effects on the human body.

The method of treatment is known variously as short wave therapy, ultra-short wave therapy, radiothermy, radiathermy, short wave diathermy, and so on.

The apparatus is not entirely safe or simple to operate, and it is, I believe, the consensus among experts in physical therapy that these machines need further perfection and more clinical study. The reputable manufacturers view with alarm the fact that they are forced to rush hastily to the making of these machines in order to protect themselves in a highly competitive field. One engineer, representing a high frequency concern, speaking to a group of physicians, recently made the statement: "We as manufacturers, have a great deal to learn as regards the construction of short wave equipment."

The application of electrodes is not a simple matter. It is stated by the experts in this field that it is necessary to space them with extreme accuracy at measured distances from the skin surface in order to obtain proper localization of heat. No satisfactory orificial electrodes have yet been devised. There is always difficulty in avoiding concentration of heat from the cables leading to the electrodes, because the field that is produced by the cables is nearly as powerful as the fields of the electrodes themselves.

It is most dangerous to attempt to give these treatments through clothing. One reputable manufacturer advises: "If you use the electrodes over clothing, you are bound to produce perspiration, and will and must get burns." Kovacs writes: "The application of electrodes over the clothed body makes a close observation of incipient burns of the skin impossible; it also breeds carelessness in neglecting the elementary rule of close inspection of the parts before and after every treatment."

In the condenser field between the electrodes, hot spots occur constantly in areas of moisture. In more than a year's observation of short and ultra-short wave machines, I have observed that, whenever the part becomes heated and perspiration forms, there is annoying burning. While this burning is relatively infrequently followed by anything but the mildest of first degree burns of the skin, still, the phenomenon is one of the greatest drawbacks to short wave diathermy. Even when every effort is made to keep the skin dry by means of dry towels or dry felt next to the skin, burning sensations are far more common than is the case with ordinary diathermy. In addition, deep tissue burns of severe nature have been reported by several workers. Schmidt reports a severe coagulation of the tissue beneath the skin in one case, with little change in the skin itself. Another investigator reports that, while testing a short wave machine on himself, he received a severe 1½-inch circular burn of the skin "without having felt it at the time of its production." Coulter has reported the observation of skin burns from short wave therapy "entirely comparable in their appearance to those produced by ordinary diathermy." Not only, therefore, is the statement that "burns are impossible" entirely fallacious, but also one may go further and say that, in the absence of actual burns, burning sensations are more common than with ordinary diathermy, even when the most careful technic is employed.

The fact that it is claimed that less time is necessary to heat the tissues with short radio waves than with ordinary diathermy merely emphasizes the point that these machines may have a greater energy output and hence are potentially more dangerous.

There are, to date, very little clinical data to show that short wave therapy has any great advantage over ordinary diathermy. Whereas Schliephake claims superior penetration, Schultze and Rach applied short waves to the pelvis, with electrodes over the symphysis and under the buttocks, measured the temperature in the urine-filled bladder, vagina and rectum with alcohol thermometers, and concluded that a pronounced heat effect could not be recognized in these regions, although a noticeable heating of the skin could be ascertained and the patients felt definite sensations of heat.

Treatment of Rheumatoid Arthritis with Fever Induced by Diathermy

A Follow-Up Study

Charles L. Short, M. D., and Walter Bauer, M. D., Boston, in J. A. M. A., 104:24:2165, June 15, 1935.

Our patients had all been thoroughly studied in the medical wards before treatment was instituted and fulfilled the diagnostic criteria of rheumatoid arthritis. Most of them had received general treatment, including a high vitamin diet, rest, control of pain, physical therapy, and the removal of obvious foci of infection. During the follow-up period, such general treatment as seemed indicated was pursued. They were all given one or more treatments by means of a Victor superpower diathermy machine and the electrodes described by Neymann and Osborne. During application of the high frequency current and after the electrodes had been removed, the patients were insulated with warm air by means of a box containing electric lamps, and their temperatures were thus maintained. They were given fluids at room temperature as desired and were kept more comfortable by cold compresses on the head and the use of an electric fan. A mixture of opium and alkaloids in doses of one-third grain (0.02 Gm.) was used also. It is fair to state that the experience was a harrowing one for most of the pa-

tients and that treatments were not uncommonly followed by headache, nausea and vomiting, and severe herpes. Patient nine expressed himself as "knocked out" by the treatment for three weeks. Undoubtedly some of this discomfort was due to the excessive sodium chloride loss in the sweat and could have been eliminated by the oral administration of sodium chloride in the course of the treatment, as advocated by Simpson.

In all, seventy-one treatments were given our group of twenty-five patients, with the temperature usually maintained at 104° F. or over for two hours. Patients two, three and twenty-two, were given briefer treatments lasting from two to three hours, at lower temperatures (from 102° to 103° F.).

An attempt has been made to follow this group of twenty-five patients as carefully as possible after their diathermy treatments. Nine have been followed for three years or more, nine for two years or more, and all but one of the remainder for over a year. The final survey shows that five, or twenty per cent, were improved; seven, or twenty-eight per cent, were essentially unchanged, while thirteen, or fifty-two per cent, were worse. Concerning the severity of the treatments, these results seem hardly to justify the continued use of this form of therapy.

What of the five who improved? Is there any way of foretelling which patients might benefit from this treatment? Briefly, they were younger than the others (three were under thirty), their arthritis was of shorter duration, they showed in general little or no cartilage destruction or limitation, and, finally, all but two demonstrated more marked vasomotor changes. Furthermore, in the course of the treatment the increase in pulse pressure, which we believe to be an index of vasodilatation was more marked than in the group that did not improve. We consider therefore, that, in common with other measures which help rheumatoid arthritis, such as the use of typhoid vaccine intravenously, physical therapy and possibly salicylates and ammonium orthoiodoxyl benzoate, fever therapy acts by increasing the blood supply of the affected tissue. Berris and King agree that the increased peripheral circulation is the important therapeutic factor, while Nichols and her associates ascribe the temporary decrease in joint swelling to dehydration of the body.

Summary and Conclusions

Twenty-five patients with rheumatoid arthritis were given seventy-one artificial fever treatments by means of general diathermy.

The number of treatments given each patient varied from one to fifteen, and the usual temperature maintained was 104° F. for four hours.

While no patient was seriously injured by this treatment, all looked on it as a harrowing ordeal.

Eighty per cent of our cases showed temporary improvement, but in only twenty per cent was this maintained until the end of the trial period.

When we balance the results obtained against the severity of the treatment, our conclusion is that in rheumatoid arthritis the use of this method is only occasionally justified and should not be used to the exclusion of general treatment.

Fever Therapy

Results for Gonorrheal Arthritis, Chronic Infectious (Atrophic) Arthritis, and Other Forms of "Rheumatism"

Philip S. Hench, M.D., Charles H. Slocumb, M.D., and Walter C. Popp, M.D., Rochester, Minn., in J. A. M. A., 104:20:1779 May 18, 1935.

Comment

Since our results with the Kettering hypertherm are approximately the same as those obtained with other methods, we agree with Simpson that the use of properly heated cabinets should replace more elaborate methods. Certainly this method is simpler and less expensive than radiothermy. Simplification of methods to avoid danger and expense and to increase the sphere of hyperthermia's usefulness is highly desirable. We regard as justified the lessening popularity of radiothermy and "superdiathermy" in favor of heated cabinets. Simplification must not be carried, however, to the point of therapeutic ineffectiveness. There is already a tendency to propose methods of supposed "fever therapy" incapable of providing adequate degrees of fewer or of producing much more than the local thermic reactions of ordinary physical therapy.

The results in gonorrheal arthritis are in striking contrast with those in nonspecific infectious arthritis, the figures in the two groups being almost the converse of each other. Of patients with gonorrheal arthritis, well over two-thirds are promptly "cured" and practically none go without considerable relief. Of patients with chronic infectious arthritis, about two-thirds get little or no relief and only a third are benefited significantly. It is a point for debate how far fever therapy is justified in cases of chronic infectious arthritis if it but infrequently provides more than relief of grade two. Many less expensive, more available and less strenuous forms of therapy do that much almost as a routine. Based on experiences to date, it seems only fair to tell a candidate for fever therapy who has chronic infectious arthritis that his chances for having the progress of his disease stopped sharply are probably no more than one in five, if that much, and that his chances of receiving little or no benefit are about fifty per cent. If his condition is of long duration or markedly active, or if he has practically ignored older or more orthodox measures, it would seem best to postpone a trial of fever therapy in favor of current therapy of proved usefulness. But it is in just such long standing and severe cases that one turns in hope to new methods. If the victim has tried other measures faithfully with but little success, if he understands the likelihood of relief, and if he can afford the treatments without undue financial sacrifice, then a trial of hyperthermia seems quite justified. It must be remembered, however, that success is more frequent in cases of short duration and of moderate activity.

Regardless of the apparatus or the method used, such therapy will probably never be inexpensive or cheap, for its physiologic effects are potent and it must always be completely under control. The constant presence of trained attendants is required, with a physician either in attendance also or within immediate call.

In gonorrheal arthritis, results are so striking and apparently so superior to those obtained by other methods that one can prescribe fever therapy as the method of choice with considerable assurance. Even though the cost is a matter of consideration, the prompt relief obtained and the avoidance of crippling deformity, formerly so often a feature of gonorrheal arthritis fully justify the expense. In a case of doubtful etiology, in which gonorrhea is suspected but cannot be proved, the patient should be given the benefit of the doubt and subjected to two or three adequate sessions of fever. If a striking result is obtained promptly, the chances are that

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the cause was indeed the gonococcus. Even in cases of old, chronic gonorrheal arthritis in which the continued presence of viable gonococci may seem remote and secondary invaders are under greater suspicion, a trial of a few sessions of fever is nevertheless in order, and particularly if appreciable degrees of inflammatory activity (tenderness, swelling, and pain on motion) still accompany the residual deformity. The "fire" may finally be stopped by fever therapy, but fever therapy should be looked on as a "fire brigade" and not a "corps of carpenters": it may extinguish the fires of gonorrhea but will not restore the architecture of a joint. Therefore, when a process is practically burned out except for residual stiffness, fever therapy is probably not indicated.

The difference between results for the two types of arthritis would seem to support the contention that, in gonorrheal arthritis, fever therapy exerts a direct (sterilizing) effect but that in nonspecific infectious arthritis its effect is largely if not entirely indirect. If the latter disease is bacterial in origin, its causative germ (streptococcus or otherwise) is obviously not one mortal to the degrees of fever available in clinical hyperthermia. A corollary of this would be that if any of the supposed arthrotropic bacteria put forth as being the primary etiologic agent are found capable of being fairly readily killed in vitro at temperatures available in fever therapy, they are probably not the cause of the disease and claims for them should be discarded. Such a conclusion seems only logical. Practically nothing is known about the thermal death time of streptococci, a field for immediate investigation if rational dosage in hyperthermia is to be attempted. Indeed, similar investigations on the thermal death time of all organisms pathogenic to man would seem indicated to determine their susceptibility not to a few minutes of intense heat in vitro but to several hours at lesser temperatures in vivo. It would be a grim joke if of all such pathogenic organisms only one was susceptible to the direct action of hyperthermia. Fever therapy may yet prove "specific" for more than the gonococcus.

Summary and Conclusions

A survey of experiences with fever therapy for various types of arthritis indicated that results have been quite variable. No one method has been proved clearly superior to all others, and a laudable process of simplification of methods is in progress.

Of cases of chronic, nonspecific infectious (atrophic) arthritis, "cures" have been reported in from nothing to twenty-five per cent, marked relief in from nothing to seven per cent, moderate relief in from twenty-five to fifty per cent, and no relief in from thirteen to seventy-five per cent. We have estimated that, of the total number of patients treated, an average of about ten per cent were reported as becoming symptom free, about twenty-five per cent reputedly obtained marked relief, and about thirty-five per cent obtained moderate relief, and about thirty per cent obtained no relief.

The results in our cases have not equalled these general averages but have approximated the more modest estimates. Of our sixty patients with chronic infectious arthritis none were completely relieved; eighteen per cent were markedly relieved, twelve per cent were moderately relieved, twenty per cent were but slightly benefited, and fifty per cent were not relieved. Thus a total of thirty per cent received significant benefit and seventy per cent got little or no relief.

The value of fever therapy for chronic infectious arthritis cannot yet be fully appraised. Further clinical experience is necessary as well as further investigation on the thermal death time of supposedly etiologic bacteria. In the meantime, a trial of fever therapy in selected cases is justified.

Of cases of gonorrheal arthritis "cures" have been reported in from fifty to one hundred per cent, with complete relief occurring in a total average of ninety-two per cent. Only occasional patients are not markedly benefited.

Our results in sixteen cases of gonorrheal arthritis confirm those of others. About ninety per cent of our patients were essentially cured or markedly relieved. Adequate fever therapy seems to provide a direct sterilizing effect and affected joints.

Since one may expect from adequate fever therapy a fairly rapid and essentially complete recovery in the majority of cases of acute gonorrheal arthritis (without the articular residues that so frequently occur in spite of other measures), and since even in cases of chronic, but still active, gonorrheal arthritis considerable benefit can often be obtained, the prompt use of this form of therapy is recommended.

Fever Therapy for Gonococcic Infections

Arthur U. Desjardins, M.D., Louis G. Stuhler, M.D., and Walter C. Popp, M.D., Rochester, Minn., in J. A. M. A., 104:11:873, March 16, 1935.

Contraindications

In the past, advanced age, cardiac and renal disturbances, arteriosclerosis, pulmonary tuberculosis, and diabetes have repeatedly been mentioned as formal contraindications to fever therapy in general. There is no doubt that old age, organic lesions of heart and kidneys and arteriosclerosis greatly increase the risk of fever therapy. As for pulmonary tuberculosis, and tuberculous lesions generally, there are reasons for believing that, in selected cases at least, fever therapy may indeed prove a valuable therapeutic procedure. This possibility is now being investigated.

Wilder and others have demonstrated that well controlled diabetes does not preclude even major surgical procedures. For this reason, Wilder felt that diabetes, if under satisfactory clinical control, should not bar a patient from fever therapy, if this should otherwise be indicated. Having under his care a man with diabetes who had recently acquired a gonorrheal urethritis, and the diabetes having been under control for some time, Wilder referred him for fever therapy. Needless to say, other contraindicating factors did not exist. After the first session of fever the patient had a reactive flurry, but this subsided rapidly. On the whole, he tolerated the treatment just as well as any other patient and the gonococcic infection was cured. The discharge did not cease and smears continued to show gonococci until after the seventh session of treatment. This was because, at each of the early sessions, the required degree of fever was not maintaind long enough; the patient was withdrawn from the chamber after only four hours of maximal fever. If this could have been avoided, and if, from the very start, the required temperature had been maintained for at least five, and preferably six, hours, it is certain that the number of sessions could have been materially reduced. This case is not described in greater detail because Wilder intends to make a complete report of it. It is mentioned here only to bring out the fact that diabetes need not be a bar to a patient for fever therapy, but it is essential that the diabetic manifestations should be under good clinical control and that the

patient should be free from other complicating disturbances.

Comment

Treatment of this kind requires the constant attention of nurse technicians, who must be carefully selected and specially trained. Just as important, however, such treatment must have the constant supervision of a physician familiar with all the details of the method.

Fever therapy, especially for conditions that require such high temperatures, should preferably be conducted in an institution where the work can be properly organized. There is no reason why any well trained physician could not undertake such treatment. But for a physician to think that he can turn a button in the morning and leave the patient to the tender mercies of a technician while he goes down town to call on other patients and attend to his usual practice, would be a dangerous fallacy. In most cases perhaps nothing serious would happen, but the physician would never know when, on returning, he would have to face a major calamity, the responsibility for which would rest on him and not on the technician.

A Comparison of Three Electrical Methods of Producing Artificial Hyperthermia

Francis W. Bishop, Emmy Lehman, R.N., and Stafford L. Warren, M.D., Rochester, N. Y., in J. A. M. A., 104:11:910, March 16, 1935.

Since January 1930, four hundred and forty-eight treatments have been given to three hundred and twelve patients. The diathermy method was used for one hundred and fifty-seven treatments, the radiotherm for twelve treatments, on twelve patients, and the radiant energy method for two hundred and seventy-nine treatments. Three of these patients were treated with both the radiotherm and diathermy, with an interval of from one to three weeks between.

Since the results in this clinic seem to be identical, no matter what the method of elevating the temperature may be, a comparison may be based on cost and case of use.

The first method requires a diathermy machine of fairly large power, representing an investment of from $200.00 to $900.00, with associated equipment such as electrodes and binders. There will be a certain cost of maintenance. Considerable time is required to apply the electrodes properly, as well as to readjust them if they became disarranged during the period of heating. If the electrodes become loosened through movements of the patient, electrical burns are likely to occur. In unstable or refractory (paretic) patients this is a potential danger. There may be variable upward coasting of the patient's temperature after the diathermy machine has been turned off depending on the amount of heat temporarily stored in the tissues through which the current has been passing. The energy applied by this method is rather localized, and the rise in general temperature is brought about by the circulation of the heated blood to other parts of the body.

In the third system under consideration radiant energy (infra-red and visible radiation) is applied to the skin over a large area. The distribution of heat is brought about in the same manner as all other methods, that is, the circulation of the warmed blood to other parts of the body. The heat transfer of the method is comparatively rapid, since the blood is so diffusely distributed over the whole body in the capillary bed of the skin that it is really heated by the absorption of radiant energy. The temperature rise starts immediately after the patient is exposed to the radiation and the rise is uniform and ceases practically at once when the radiation is turned off. The fact that there is little or no upward coasting of the patient's temperature when the radiation is turned off indicates that the blood stream conveys the heat away about as fast as it is supplied, and therefore the skin temperature is not excessively raised (maximum forty-three C. before sweating begins). Blisters may be produced if the energy input is pushed too far in some area of decreased circulation (scars, edematous areas and the like), or if some part should come too close to the lamps. These can be avoided if a towel or sheet is placed over the part as soon as a hyperemia is noted. Any method that applies energy diffusely over a large area of the body automatically reduces the danger of too great concentration and consequently burns. It seems obvious from a physical standpoint, physiologic processes (sweating) being disregarded, that to raise the temperature of a patient of a certain weight to a given degree it will require the absorption and retention of a definite amount of energy. For example, assuming 0.83 as the average specific heat of tissue and $h = 0.24\ I^2Rt$ (Joules law), to raise a 60 Kg. patient 5 degrees C. in one and a half hours would require an effective energy of approximately 200 watts continuously applied during the interval, or 300 watt hours.

The use of radiant energy has also made it possible to extend the period of fever greatly at any given height (from twenty-one to twenty-four hours). Any rise or fall in rectal temperature may be compensated for very simply and quickly by the use of the rheostat. The simplicity of the equipment enables one to administer to the comfort of the patient somewhat, such as by changes in position, pillows and rubber rings, and to foresee and handle sudden changes in condition. It is possible to direct a small electric fan at the patient's head and let him have cracked ice at intervals, since the heat loss from this cause can be made up easily. The cost ($150) entails the building of a suitable cabinet wired for the lamps and the purchase of a rheostat. The usual thermometers, blood pressure equipment, oxygen tank and records complete the equipment. A standard indicating or registering resistance thermometer may be purchased for from $150 to $300 from several instrument makers. A constant indication of the rectal temperature aids greatly in manipulating the heat input to maintain the rectal temperature at a desired level.

Summary

While any of the electrical methods proposed can be made to work efficiently and safely in artificial hyperthermia, the radiant energy (infra-red) method described seems to be the most convenient and economical method in our experience.

There does not appear to be any difference in the clinical effects and results from the various methods used.

All these methods rely on the circulation of the blood for the redistribution of heat in the body from the site of application of the energy.

Book Reviews

DIATHERMY IN GENERAL PRACTICE, by Eric P. Dark, M.C., M.B., Ch.M. (Syd.) Late Radiographer, Royal Prince Alfred Hospital, Sydney; Demonstrator of Anatomy, University of Sydney, with chapters by F. A. Maguire, C.M.G., D.S.O., M.D., Ch.M. (Syd.), F.R.C.S. (Eng.), F.R.A.C.S., Honorary Gynecologist, St. Vincent Hospital, Sydney and Guy P. U. Prior, L.R.C.P. (Lond.), M.R.C.S. (Eng.) Superintendent Mental Hospital, Parramatta, N. S. W.: Second Edition, 219 pages, illustrated. Cloth Price 17/6, Sydney, Angus and Robertson, 1934.

Dr. Dark is an enthusiast about the value of medical diathermy in general practice. There are chapters on its use in fibrositis, injuries, neuritis, rheumatic conditions, pneumonia, high blood pressure, and gonococcal infections. The technics for its uses in these conditions are given clearly and are well illustrated. Usually case histories are given under each of the above subjects to illustrate the results obtained with medical diathermy. Some of these successes seem too good to be true.

Dr. Maguire wrote the chapter on diathermy in gynecology and Dr. Prior has written the chapter on the use of diathermy in mental disorders.

The tone of the entire book is one of over-enthusiasm as can be illustrated by the statement, "when one has become accustomed to use a portable diathermy machine, it seems as essential as a portable hypodermic syringe."

DIE PHYSIKALISCHEN UND TECHNISCHEN GRUNDLAGEN DER HOCHFREQUENZBEHANDLUNG: Diahermie, Arsonvalisation, Kurzwellen von Dor. Med. Et Phil. Hans Weisz, mit einem geleitwort von J. Kowarschik mit 36 Testabbildungen. Wien Verlag von Julius Spinger 1935. Price R N 3.90. Pages 73.

This small concise but authoritative manual will appeal particularly to the person who is interested in physics as applied to electrotherapy. It deals chiefly with the physics of the high frequency current. While it is quite technical it is yet so simply written that one should have little difficulty in understanding it.

The greater part of the book is given to the discussion of the physics of the high frequency field including the use of electrontubes. The author discusses very clearly the physics of heating by the use of the electromagnetic field, and in as much as this type of heating has recently been developed and used in this country it is very timely.

The opening chapters of the book define the nature of matter and electricity, Ohm's Law and the use of Joule's law. The author discusses the conversion of electrical energy into calorie units. The electrical laws of attraction and repulsion, field strength and lines of face are defined. He discusses the function of condensors, the meaning of conductance, inductance, capacitance, resistance, and coupling. He gives the laws which govern the change of frequency. He discusses at some length the value of electron tube circuits and gives the different types of electron tubes which are available. He outlines a grid tube high frequency circuit which is essentially the same as those of this country. The author gives the laws which determine the generation of heat in conductors such as metals and tissues. He also shows the difference in current distribution when diathermy and arsonvalization is used.

THE CRIPPLED AND THE DISABLED: Rehabilitation of the Physically Handicapped in the United States, by Henry H. Kessler. Cloth. Price $4.00. Pp. 337. New York: Columbia University Press, 1935.

During the period when the United States has passed for the first time a social security bill, it is peculiarly appropriate to have a book which considers the struggle of the disabled for an economic and vocational status. The author believes that the struggle of the disabled for economic and vocational status appears to have been solved in Soviet Russia by the absorption of the disabled into the industrial economy. This has been achieved by a revolutionary political concept of the status of each individual rather than by a class. This volume is a study as to the feasibility of a similar achievement in the democratic and capitalistic society of the United States.

Part One is devoted to general considerations of the problem of the disabled. Following this the disabled as a group of vocationally maladjusted persons, are subdivided into the child cripple, the industrially disabled, the war disabled, the chronically disabled, and those disabled by defects of the special senses. Specific and general legislation in the United States and in the foreign countries is examined, studied and critically evaluated.

The author is the medical adviser to the New Jersey Workmen's Compensation Bureau and Rehabilitation Commission. He has had extensive experience in the rehabilitation of the disabled, and this volume describes his opinion of how society is gradually reducing the two great social barriers to rehabilitation, the psychosocial and economic prejudices. This book is recommended to anyone interested in the socialogical and economical aspects of rehabilitation.

NUTRITION AND PHYSICAL FITNESS, by L. Jean Bogert, Ph.D., Consultant in Nutrition, Delineator Institute, New York; Formerly Instructor in Medicine, University of Chicago; Instructor in Experimental Medicine, Yale University; Research Chemist, Obstetrical Department, Henry Ford Hospital; Professor of Food Economics and Nutrition at the Kansas State Agricultural College. Second Edition, thoroughly revised. 566 pages with 65 illustrations. Philadelphia and London: W. B. Saunders Company, 1935. Cloth, $3.00 net.

The subjects considered in this volume have a definite value to every physical therapist. Food is not all there is to nutrition. The author notes that there are two main aspects of nutrition, the food intake and what the body does with it. The significance of body structural differences from the standpoint of nutrition are carefully considered.

This second edition contains many revisions and the chapter on Vitamins has been completely rewritten. The book is written in a simple manner giving not only the theoretical information but practical data on foods and their preparation. The book is divided into five parts: foods, body requirements, body processes, meal planning and diets for special conditions.

Diets have a special interest for the physical therapist because many conditions requiring physical therapy likewise need special diets.

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